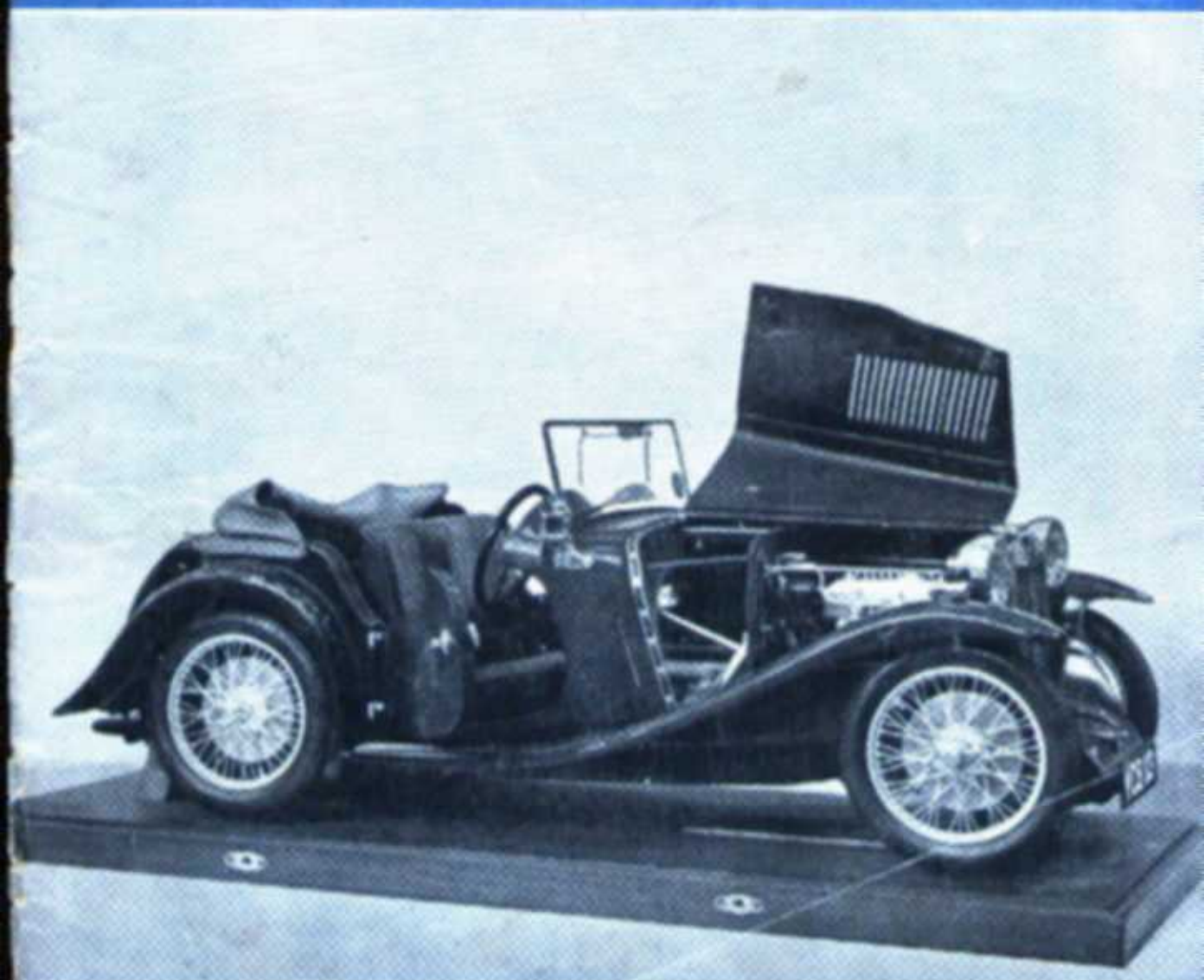
THE MODEL ENGINEER



IN THIS ISSUE

● THE DUKE OF EDINBURGH HONOURS MODEL ENGINEERING
NOTES ON LATHE DESIGN ● THE HYFORD H.L.T CLUTCH UNIT
● A MODIFIED "DUPLEX" JIGSAW ● FITTING LATHE CHUCKS
L.B.S.C.'s "MIGNETTA" ● THE ALLCHIN "H.L." TRACTION ENGINE

MARCH 11th 1954
Vol. 110 No. 2755

9D

THE MODEL ENGINEER

EVERY THURSDAY

Volume 110 - No. 2755

MARCH 11th 1954

ESTABLISHED 1898

PERCIVAL MARSHALL & CO. LTD. 19-20 NOEL STREET · LONDON · W·1·

CONTENTS

SMOKE RINGS	253
THE DUKE OF EDINBURGH HONOURS MODEL ENGINEERING	254
THE ALLCHIN "M.E." TRACTION ENGINE	255
L.B.S.C.'s "NETTA"	259
OSCILLATING PISTONS FOR ENGINES AND PUMPS	262
THE MYFORD M.L.7 CLUTCH UNIT	264
QUERIES AND REPLIES	266
FROM SCRAP TO TRACK	267
NOTES ON LATHE DESIGN	269
TWIN SISTERS	272
FITTING LATHE CHUCKS	274
READERS' LETTERS	276
RELIC OF THE PAST	277
A MODIFIED "DUPLEX" JIGSAW	278
WITH THE CLUBS	279

Our Cover Picture

Although the motor car is a very popular subject for model construction nowadays, most models of this type have either been solid scale models, with no attempt whatever to reproduce internal mechanical fittings, or racing models in which the main emphasis is on power plant, and mechanical details are purely functional with little or no regard to correct scale or appearance. The model shown here, however, is of outstanding interest as an example of true scale modelling in which full mechanical detail is also incorporated.

The model, which was made by Mr. Frank H. Buckley, of Ashford, Middlesex, and exhibited in the 1952 "M.E." Exhibition, represents a 1935 "P" type M.G. car to a scale of 2 in. to the foot; it was copied from the full-sized car and has working brakes, lighting, horn, etc., also correct steering, springing and suspension. The engine is externally correct but is fitted internally with an electric motor, which drives the rear wheels through a working gearbox, with its controls, and orthodox transmission system.

SMOKE RINGS

"M.E." Exhibition Demonstrations

PREPARATIONS ARE in hand for the usual Demonstration stand at this year's MODEL ENGINEER Exhibition, where visitors will be able to watch various processes in woodwork, metalwork, ship modelling, soldering and brazing; Brigadier D. J. R. Richards will be in charge, once again. One of the most useful of these demonstrations, so far as a very large number of our readers are concerned, is that of brazing and silver-soldering parts and fittings of boilers; and in this sort of work there will be the opportunity for anybody in difficulties to have such jobs done by experts on this stand during the run of the exhibition. This has proved to be a very popular feature on previous occasions, so anyone who has any small brazing or silver-soldering job to be done is advised to make a note of this offer. The job will be done for nothing, except the cost of the brazing material; but it will not be possible to undertake the entire brazing of, say, a boiler for a 5-in. gauge locomotive! Only small jobs can be dealt with, and the more of them the better.

High Railway Speed

THE RECENT trials of one of the new electric locomotives now being delivered to the French National Railways (S.N.C.F.) has aroused considerable interest, on account of the speeds attained. In 1903, a German electric locomotive created a record by reaching a speed of 133 m.p.h., and this remained unbeaten, for electric traction, until February 20th this year, when the French locomotive reached 137 m.p.h. while hauling a special train weighing 120 tons. The following day, however, a further test was made with the same locomotive and train, and this time, the maximum speed attained was 150 m.p.h. These runs were made between Dijon and Beaune, on the former Paris, Lyons and Mediterranian line, which section has been something of a "galloping ground" for a long time.

Quite apart from the economics of the matter, the speed of 150 m.p.h., on the railway, is something to be proud of; it will certainly take some beating! But we wonder if such a speed will ever become a regular feature of a railway timetable.

"Austerity" 2-10-0 Locos

SEVERAL READERS have written to point out what they describe as an error in our article on "Britain's new 'Decapod' Locomotives," and inform us that one hundred and fifty, not twenty-five, were built in 1943-4. We agree; but our article was referring to ten-coupled engines that had been used on the railways of Britain, and in this respect the reference to twenty-five of the "Austerity" 2-10-0 engines is correct.

But there *is* an error in that same reference, and it is in giving Crewe as the place where they were built. This seems to have arisen through the misunderstanding of information; the fact is that all the engines of this class were built by the North British Locomotive Co. Ltd., Glasgow, and all except twenty-five were sent overseas. We have to thank two Glasgow readers for calling our attention to this.

News from Australia

MR. STAN MILLIGAN, hon. secretary of the Surrey Hills Live Steamers, Victoria, Australia, has sent us a very cheery report of a recent Track Day at the home of Mr. Roger Pearman at Montmorency, about 12 miles from Melbourne.

Mr. Pearman is an Englishman who went out to Australia from Birmingham a few years ago; he and his wife are building their own house, but the track for Mr. Pearman's locomotive has been completed. On the day in question, many locomotives were taken along by S.H.L.S. members; each was limited to 20 minutes for running. The majority of the engines are to "L.B.S.C." specifications, and there is no mention of any failures.

The DUKE of EDINBURGH honours MODEL ENGINEERING

This photograph gives a good impression of the craftsmanship and attractive design of the trophy, although it hardly does justice to its size. Actually the tankard is nearly 12 in. high, including base

IT is with genuine pride and pleasure that we are able to make an announcement which we are sure will thrill model engineers everywhere. His Royal Highness the Duke of Edinburgh, whose keen interest in model engineering was so clearly apparent at "The Model Engineer" Exhibition in 1952, has graciously consented to the annual award of a prize which is to be known as "The Duke of Edinburgh Challenge Trophy."

The prize is the very handsome silver tankard, a photograph of which is reproduced herewith, and it is to be awarded in accordance with certain conditions which have been approved by the Duke; these are:—

(1) The Trophy shall be known as "The Duke of Edinburgh Challenge Trophy" and shall be awarded to the winner of the Championship Award at "The Model Engineer" Exhibition, organised by Percival Marshall & Co. Ltd.

(2) The Trophy shall remain at all times the property of Percival Marshall & Co. Ltd.

(3) The name of the winner and the date of the year in which the award is made shall be engraved on the Trophy, which may remain, at the discretion of Percival Marshall & Co. Ltd., in his possession until required for renovation and display at "The Model Engineer" Exhibition of the following year.

The winner shall be presented with a suitably inscribed tankard for his permanent retention.

(4) Any piece of model engineering work shall be eligible for the Championship Award three years after it has been awarded, at "The Model Engineer" Exhibition, a Championship Cup, Gold or Silver Medal or one of the Cups donated by "Friends of the Exhibition."

(5) The Trophy shall be awarded only to the maker of the model and a model may be entered by a maker notwithstanding that it is no longer his own property.

(6) The winning model shall not be eligible for re-entry for the Championship Award, but the makers of the unsuccessful entries may re-submit their models after a period of five years shall have elapsed.

(7) Entry, which shall be free, shall be made on the official Competition Entry Form. Competitors must state on the Entry Form:

(a) that the model has not been structurally altered since winning the qualifying award;
(b) any parts or kits which were purchased or were not the outcome of their own work;
(c) the origin of design; and
(d) that exhibits are their own bona-fide work.

(8) Due to restrictions of space the entry of models for the Championship Award shall be no guarantee of acceptance, but, subject to this proviso, the first completed Entry Forms opened in respect of such models shall have a prior claim to acceptance, and models not accepted in one year shall take precedence for acceptance in the following but not in any subsequent year.

(9) The Championship Award shall be made by a judging panel of three experts nominated by The Society of Model and Experimental Engineers, the Society of Model Aeronautical Engineers and The Guild of Model Shipwrights, under a Chairman to be appointed by Percival Marshall & Co. Ltd.

(10) The decision of the Judges shall be final.

(11) Percival Marshall & Co. Ltd., reserves the right to refuse any entry, or model on arrival at the Exhibition, and shall not be required to furnish any reason for so doing.

(12) Percival Marshall & Co. Ltd., reserves, and may exercise or delegate, the exclusive rights to describe and photograph any models entered for competition and to make use of any such photographs or descriptions in any way they may think fit. (This reservation does not apply to photographs taken for publication in daily or local newspapers).

(13) Competitors will be entitled to a free Competitor's Pass to the Hall during the Exhibition. Passes will be sent or given to the Exhibitors when the models are received at the Hall. (These passes are not transferable).

(14) Percival Marshall & Co. Ltd., may, at its sole discretion, vary the Conditions of Entry without notice.

The practical interest which His Royal Highness has hereby shown in our hobby is an honour which must give all of us much satisfaction, and there can be no doubt that he is endeavouring, by his generous gesture, to encourage the practice of good craftsmanship.

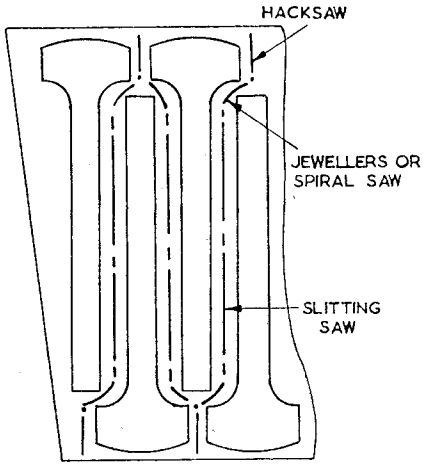
THE ALLCHIN "M.E." TRACTION ENGINE

to 1½ in. Scale

By W. J. Hughes

BEFORE carrying on with the description of the strakes, here is another method of cutting out spokes from sheet metal, sent to me by H. R. Griffin of Mansfield. In his letter, Mr. Griffin gave a couple of " 'ints and tipses," as "L.B.S.C." might say, to pass on to the lads.

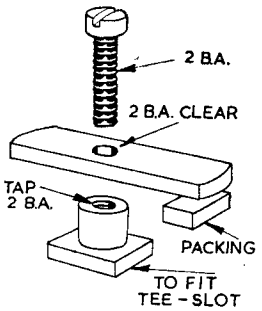
The method of cutting out spokes has two benefits: First, it doesn't waste as much material as that previously described, and secondly it eliminates the straightening of the spokes after shearing or chiselling out. Moreover, as Mr. Griffin says, " it hands some of the hard work over to the lathe."



Another method of cutting spokes from sheet, as sent in by H. R. Griffin of Mansfield

A strip of plate sufficient to make about a dozen spokes is set out as in the sketch, and the plate is clamped to the vertical-slide. A slitting-saw is mounted on a long stiff bar between centres, and a cut is made along the chain-dotted lines. The rest of the cut can be made with a hack-saw and a coarse jeweller's saw, or spiral saw; the spokes are then finished by milling.

Mr. Griffin's other gadget is for holding sheet metal on the slides. Being more compact, it does not get in the way as tee-bolts might. The nuts are turned from square bar, to fit the tee-slots, and tapped 2 B.A. Clamps are cut from sheet or flat bar, and small bits of hard-board are used as packing. Thanks a lot, Mr. Griffin, for passing on your hints.



Mr. Griffin's " patent " clamp for holding sheet metal on slides

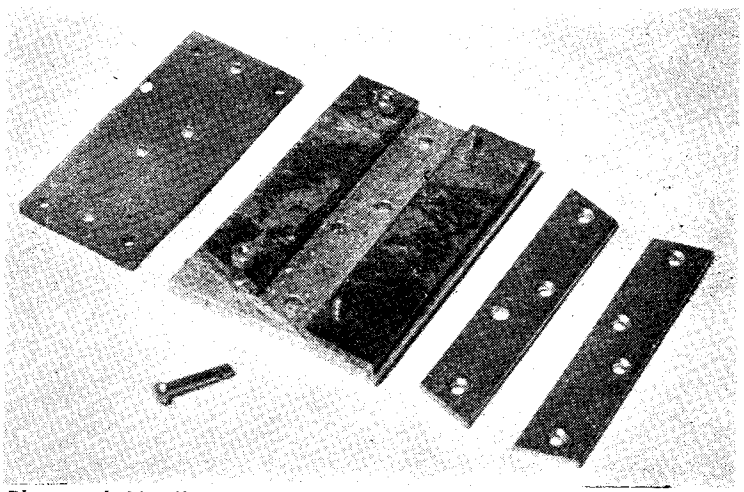
Continued from page 103, *January* 28, 1954.

As mentioned last time, there are 72 strakes, but with the aid of a simple jig for drilling and milling, the production need not be a long job.

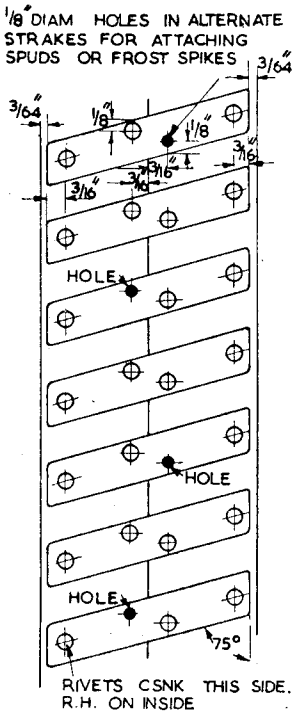
First, the blanks will need cutting to length from the $\frac{7}{16}$-in. by $\frac{1}{16}$-in. strip, which can be done with bench shears or hacksaw. In my case I used the shears, and chalked a line at 75 deg. to the jaws, on the bench. Then with a steel block at the appropriate distance from the jaws, to act as a stop—an angle-plate would do for this—the strips were quickly cropped off, allowing a little surplus for milling the ends. *Warning*: If you are using the strip which has been sheared from sheet, with its slight curve across the breadth, don't forget to make 36 left-hand and 36 right-hand strakes. In fact, keep this in mind all the time you are working on these ! After shearing, the blanks will probably need straightening with one or two light blows with a hammer, but they needn't be dead straight.

Drilling-jig

Some odd scraps of plate are required for the jig. The main plate *A* should *not* be less than



Photograph No. 60. Trevor Whitaker's jig for drilling and milling the hind wheel strakes, with two of the finished strakes



Arrangement and dimensions of strakes, as on left-hand hind wheel. Right-hand identical, but reversed

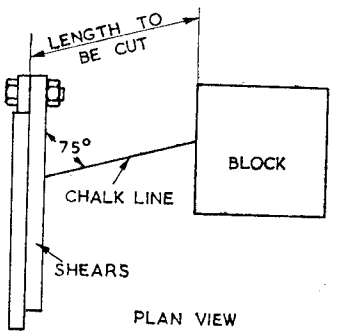
$\frac{1}{8}$ in. thick, and the strips *B* and *C* should be $\frac{1}{16}$ in. thick; you can use some of the $\frac{7}{16}$ in. by $\frac{1}{16}$ in. for this, if you have a bit to spare. Trim the long edges of one of the strake blanks with a file, and on it set out, *very* carefully, the positions of the four holes for the rivets. Drill these 3/32 in. diameter. With a toolmaker's clamp, secure it to the plate *A*, and through the four holes drill corresponding ones in *A*. Pass 3/32-in. rivets through the two outside holes, and rivet the ends over very lightly—just enough to hold the two together, but so that the heads can easily be filed off to separate the parts later.

Now the strips *B* and *C* can be riveted to *A*, with the strake acting as a jig to position them. Two rivets, countersunk each side, will suffice for each strip. Remove the central strake, and file the other rivets flush. Drill four 3/32-in. holes for the dowels, the position of which is not vital, but don't insert the dowels yet. The upper plate *D* should be not less than 16-gauge. Clamp it to the lower component, and drill all eight holes right through from underneath. Separate the two, and *slightly* countersink the holes in plate *D* on both sides. The four dowels, slightly relieved at the top, are sweated into the holes in the lower part. It is advisable to case-harden plate *D*, by the way.

Drilling the Strakes

Actually I did not make the jig which I used, because Trevor Whitaker, whom I have mentioned before, kindly sent me the one he had made and used. Basically it was the same, but he fitted 8-B.A. studs in place of the plain dowels that I have specified. In actual practice, I found that the nuts were not necessary (though they are shown in my photograph), and it was sufficient to hold the upper plate with the finger tips, when drilling.

Before drilling the strakes, it is necessary to trim their long edges with a smoothish file; they should drop easily, but without shake, into the slot in the jig. In use, the jig is gripped in the machine-vice, as shown in the photograph. Slip a strake into the slot, drop the cover-plate on to the dowels, and hold it with the finger-tips. Drill one of the holes right through, and slip a 3/32-in. round-headed rivet into the hole, which will stop the strake moving whilst the other holes are drilled. Drill the other three holes through, remove rivet and cover-plate, and slip the strake out. Repeat the operation until the strakes are all drilled, which doesn't take long. Of course, you will have



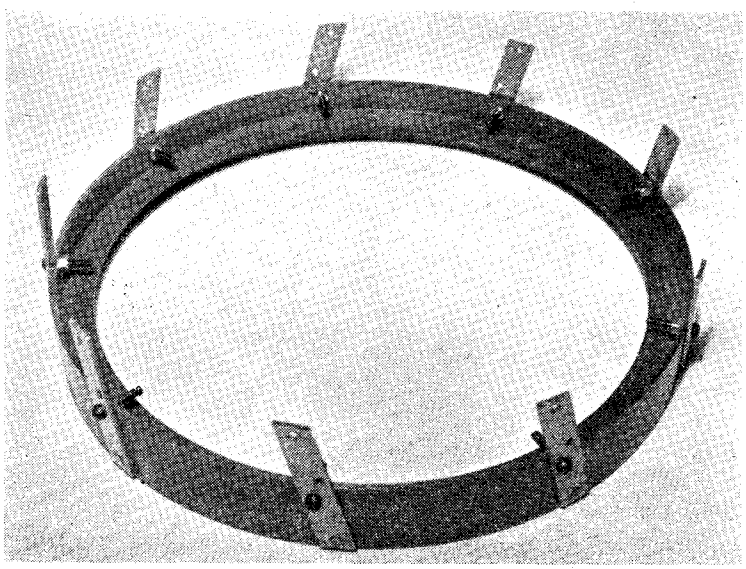
Simple set-up for shearing strakes from strip

kept the l.h. and r.h. strakes separately, and now they may be re-divided, giving four piles of eighteen each; I used four small tins to keep them separate.

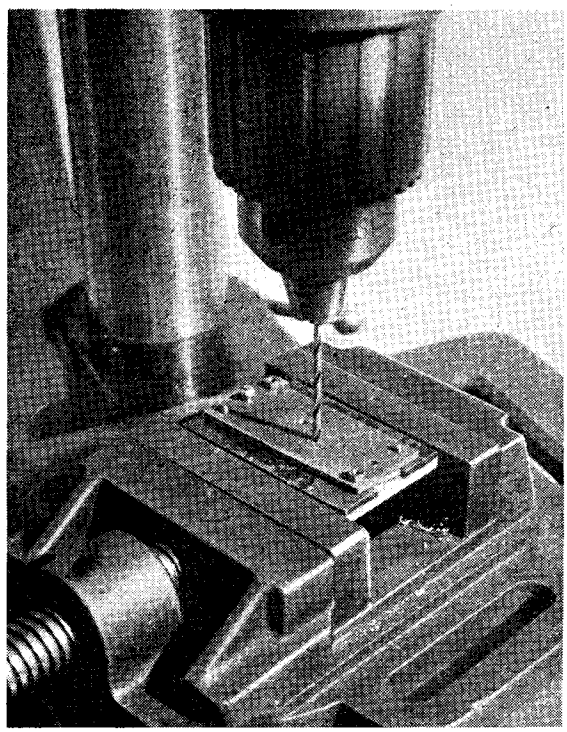
Now, in eighteen of the l.h. and eighteen of the r.h. strakes, one of the central holes should be re-drilled to $\frac{1}{8}$ in. diameter, following which all four holes in *all* the strakes are countersunk on the top surface to 5/32 in. diameter. If your drilling-machine has a depth-stop this will help you to get them all the same size. Finally, very slightly countersink all the holes underneath, to remove any flash from the edges.

Milling the Strakes

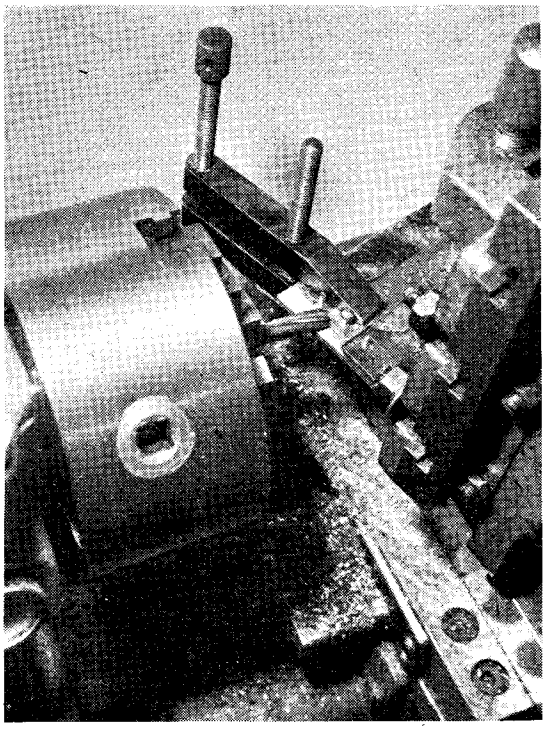
The ends of the strakes now need



Photograph No. 63. First stage in hind-wheel assembly, with nine strakes secured to tee-ring



Photograph No. 61. Using the jig in drilling a strake: note rivet through first hole



Photograph No. 62. Using the jig in milling the ends of two strakes: one of the two locating rivets is seen near the clamp

cutting to size; as Photograph No. 62 shows, I end-milled mine. Using the same jig, of course, Trevor W. had trimmed the ends of his strakes with a slitting-saw mounted on a mandrel held in the chuck. It just depends upon what you have available ! With either a slitting-saw or an end-mill, the basic procedure is the same. Grip the baseplate of the jig in the machine-vice, which is bolted to the vertical-slide, and slew the latter so that the slot is at 15 deg. to the lathe axis.

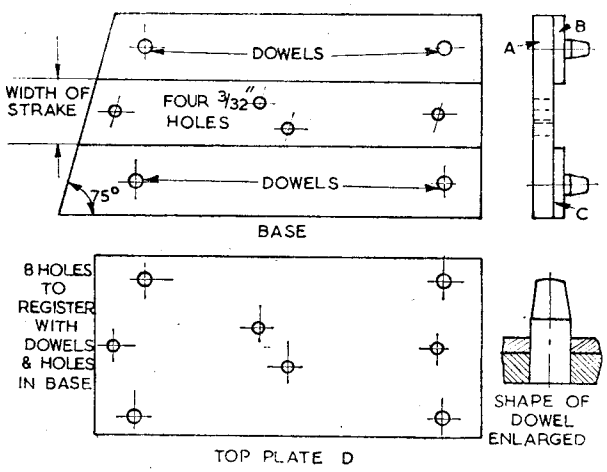
Now, with an end-mill or slitting-saw you can mill the end of the jig to 75 deg. (In Trevor's jig, he had cut only pieces *B* and *C* at that angle, and not right through the baseplate, which explains why the photograph differs from the sketch.) In my case, the strakes themselves were milled two at a time, the end-mill being $\frac{1}{4}$ in. diameter revolving at 1,020 r.p.m. (this gives a better finish than a larger cutter revolving at a slower speed, naturally). The procedure was to take two strakes, slip 3/32 in. by $\frac{1}{2}$ in. round-head rivets through the two end-holes, and place the strakes in the jig, with the lower strake in the slot and the rivets through the corresponding holes in the jig. A toolmaker's clamp was put on, as seen in the photograph, and tightened. Then in with the clutch—that fitting on the Super 7 is very useful indeed—a single cut across the end of the strakes; clutch out, slacken clamp, turn the job end for end, re-clamp, clutch in, mill ends, and, hey presto ! two strakes are finished to length.

A word of warning if you are using an end-mill gripped in the chuck. However hard you have tightened the jaws—and they shouldn't be "forced," in any case—the mill tends to move inwards, under the pressure of the cut and the vibration. Since this affects the finished length of the strakes, keep checking them against one of correct length. And don't forget 36 of your strakes will want putting in the jig "upside down," by the way.

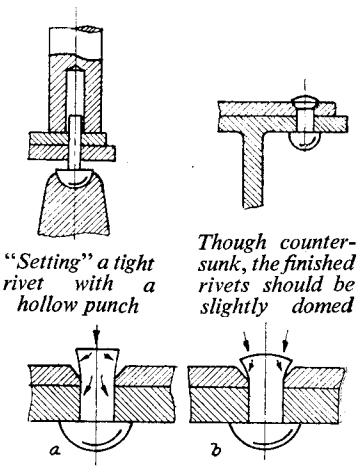
Bending the Strakes

When all the strakes are milled to length, use a small fine file to take off any sharpness on corners or edges, and they will be ready for bending. This is necessary, of course, because the strakes fit at an angle across the rims, and thus form part of a helix or spiral. Why not put 'em on square across the rim, asks the tyro ? Simple: if we did, the wheels would go bump-bump-bump, from one strake to the other; but on the slanting strakes she rolls continuously. Incidentally, it *is* important to get the strakes the correct way on the wheels, apart from copying the prototype, because, being helical, the effect is to "screw" the wheel sideways on the axle. If the strakes are the wrong way, all this side thrust is on the linch-pin which holds the retaining collar on the axle. A point for the free-lance builder to note; I've seen them wrong on one or two free-lance jobs, where the builder hasn't known better !

But to get back to bending the strakes, this is a case where simple hand-work gives good results. First of all, temporarily clamp together two of your tee-rings side by side: I found my woodwork-vice handy for that. Then, with vice-clamps in position, grip one end of a strake in the vice—metalwork vice, of course !—and slip a movable spanner or toolmaker's clamp on the other end. (If you set the jaws of the spanner or clamp a shade wider than the thickness of the strake, no need to tighten it every time.) Then, with your thumb in position



Jig for drilling and milling strakes; dimensions are not important except as stated in the text



Two stages in riveting: (a) Spreading the stem. (b) Laying the head

as sketched, twist the strake, at the same time pulling a little towards you, but resisting the pull with your thumb. Sounds complicated, but isn't really.

Try the strake in position on the rim—we've already marked the angle on the latter—and see if it needs a little more or a little less twisting. It's surprising how quickly one gets the hang of it—I found after doing one or two that I was getting them right nearly every time with the first try. The strakes must be fitted pretty accurately at this stage, as it is unwise to rely on the rivets pulling them down. As mentioned last time, the fact that the strip was initially sheared from sheet gives it a slight cross-curve, which helps the strakes to bed down properly. But again, remember the left-hand and right-hand ones !

Commencing the Assembly

We are now ready to start assembling the rims, and the first step is to fasten nine strakes to one of the tee-rings, using 5-B.A. or ¼-in. screws, washers, and nuts, and keeping them all to the correct angle of 75 deg. You will now have something like Photograph No. 63, except that in the picture a rivet has also been inserted in each strake, which is the next job.

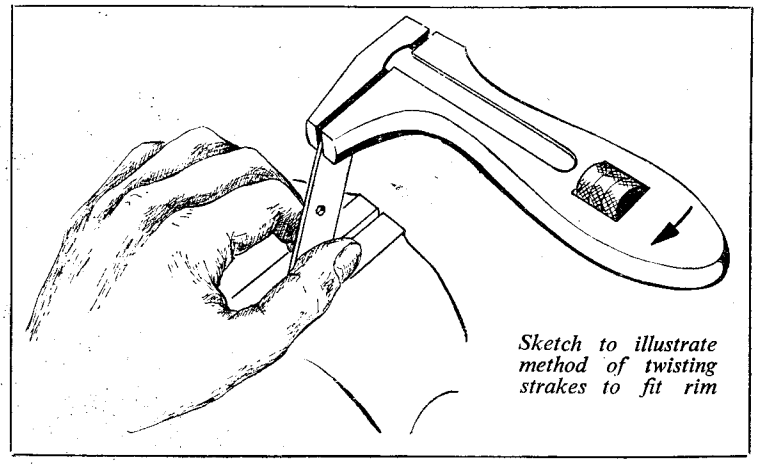
With a small toolmaker's clamp, grip the end of the strake to the rim, and drill 3/32 in. right through the hole in the strake, and the rim. Have a larger drill—say $\frac{3}{16}$ in.—handy in a hand-drill, and use this to countersink *very slightly* the hole on the inside, so that the rivet-head will bed down properly. Grip a rivet-set in the vice, and insert a 3/32-in. by ¼-in. iron rivet (round-headed) in the hole from inside. Place the rivet-head in the set, and see that it is flush with the tee-ring, especially if it's a pretty tight fit. The best way is to use a hollow punch, as sketched, tapped down with a hammer.

But, perhaps a word about riveting first ? In the prototype, these rivets were countersunk on the outside, as we are making them, but I am told that when new they were not "flush," in the strictest sense of the word. The head was left very slightly domed from the hammer, as shown, and it was left to wear and tear to bring them flat and in line with the surface of the strakes. So we can leave them likewise, without filing flush.

Secondly, the stem of the rivet must not be too long, so it will be necessary to cut some off ours. I use wire-cutters, and then give a rub with a file; in this case the end should be about 3/64 in. above the strake. On hammering the rivet, the first blows should be in the centre of the end, to expand the rivet in the hole itself, and to spread the end. The "spread" part is then laid down into the countersink by light blows all round near the edge. A ½-lb. ball-pane hammer is right for these rivets, by the way.

Having fixed all nine strakes to this ring, place the second ring in position, and bolt on nine more strakes to the *latter*, making sure that they come equally spaced in relation to the first nine. Now use

(*Continued on page* 265)



Sketch to illustrate method of twisting strakes to fit rim

L.B.S.C.'s 'NETTA'

A NORTH-EASTERN T-CLASS "MITEY" HAULER IN FIVE GAUGES

THE way in which the coupling-rods for the gauge "1" engine are made, will depend on whether the axles run in plain bushes, or in sprung axleboxes. If the former, the rods can each be made in one piece, like those shown for gauge "O." Each needs a strip of $\frac{3}{16}$-in. × $\frac{1}{8}$-in. mild-steel, about $7\frac{1}{4}$ in. long. Mark off the boss centres, as shown in the drawing, but check these off with the axle centres on the chassis, in case any slight error has been made, in drilling the axle holes and fitting bushes. As long as the holes in the coupling-rod bosses tally with the axle centres, no builder need lose any sleep by worrying. The outline of the rod can then be marked on one blank, the two riveted together temporarily by bits of rod or wire in the end holes, and the two filed up together. When the recesses in the outer faces have been put in—or cut out, which you like!—you automatically get right-hand and left-hand rods. Shaping the rods around the holes, may sound like Pat's way of making a fishing-net by getting some holes and putting string around them, but it's a good wheeze, all the same, as it ensures that the holes are in the middle of the bosses. Don't forget to countersink the holes in the first and second bosses, so that the heads of the pins fit flush, or the coupling-rods and crossheads will come to blows, instead of "gravely revolving in harmonious might," as Bro. Hambleton delightfully puts it. That lad is an artist with a pen, as well as with a pencil!

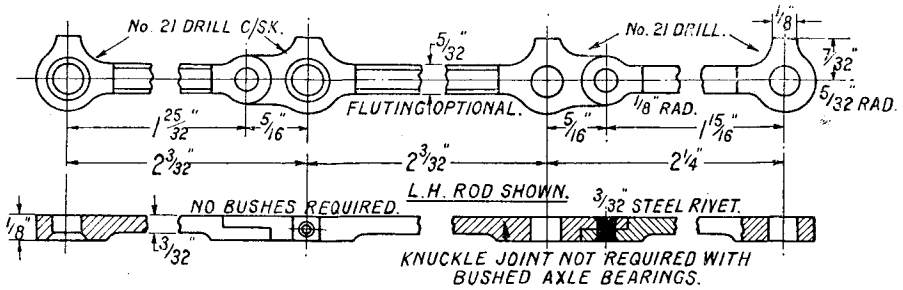
Six pieces of steel, of similar section, are needed for the jointed rods; mark off as shown on the drawing, leaving enough at each end, to form the rounded bosses. Drill $\frac{1}{8}$-in. holes at each bearing point, rivet temporarily together, each to its opposite mate, and mill or file to outline. Bits of $\frac{1}{8}$-in. wire do for rivets. The outsides are then recessed, easily done with a file. Tip for beginners: screw the rods to a bit of $\frac{3}{4}$ in. square bar, by aid of a $\frac{1}{8}$-in. screw at each end; grip the bar in the bench vice, and filing the recess is just a piece of cake, as the rod can't shift. Then, if you want to flute them, just turn the bar on its side, clamp under the slide-rest tool holder, with packing, if needed, to bring the rod to centre-height; put a 3/32-in. dental burr or home-made slot drill (see *Tich* notes on how to make one) in the three-jaw, feed the rod on to the cutter with the top-slide, and traverse across with the cross-slide. Use plenty of cutting oil. It doesn't matter about the ends of the flute being rounded. The bar can also be held in a machine vice bolted to the vertical slide, if one is available, this giving exact height adjustment.

The knuckle joints are as simple as it is possible to make them; simply pin-drill away half the thickness of each boss at the joint, as shown in the section, using $\frac{1}{4}$-in. pin-drill with $\frac{1}{8}$-in. pilot pin (also described in the *Tich* serial) filing away any surplus around the pin-drilled recess. Countersink the holes on the outside, put the two tongues together as shown, and put a piece of $\frac{1}{8}$-in. steel rod through, hammering the ends flush and filing smooth. Open the bearing holes in the bosses with No. 21 drill, and countersink the first two. No bushes are required. If the bearing holes eventually wear, they can then be opened up and furnished with bronze bushes.

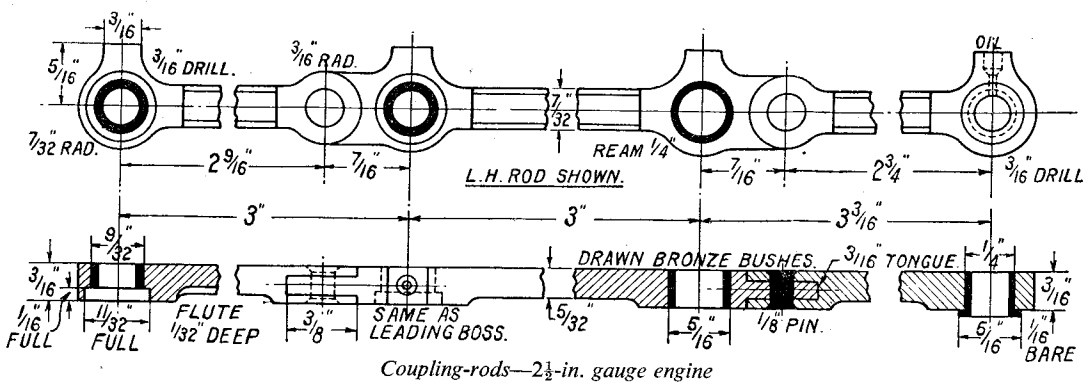
Coupling-rods for 2½-in. Gauge Engine

In the $2\frac{1}{2}$-in. gauge size, the coupling-rods are made from $\frac{5}{8}$-in. × $\frac{3}{16}$-in. mild-steel. Each rod is in three sections, all measurements being given in the drawing. Separate drawings of all the rods would have been required anyway, as they differ in details; the distances between the centres of the end bosses, and the centres of the knuckle joints, are also shown. When cutting the lengths from the bar, don't forget to allow plenty for the bosses. First mark out the centres of the bush and knuckle-pin holes, checking up on the axle-centres on the chassis, as before; then drill $\frac{1}{8}$-in. holes, and temporarily rivet the opposite numbers together.

The method by which the surplus metal is removed depends on the



Coupling-rods—1¾-in. gauge engine



Coupling-rods—2½-in. gauge engine

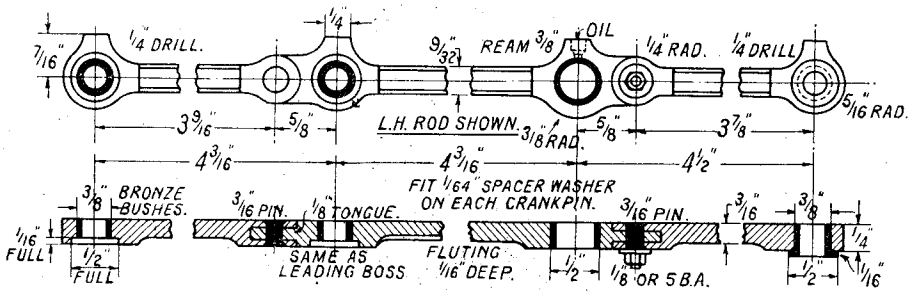
facilities available. With a milling machine, it's as easy as eating pie; all I do, is to grip the pieces in a machine-vice on the table of my horizontal miller, set them level by aid of a scribing-block, and run them under a small slabbing-cutter on the arbor. The table is raised until the cutter has bitten down to the marked line, then the self-act is engaged, and the machine does the rest; I can either set the stop so that the cutting ceases at the boss, or throw it off by hand, which I usually do. A small can, with pipe and cock, hangs on the overhead arm, and keeps the cutter wet with a 50/50 Cutmax-paraffin mixture; this gives a lovely finish. To cut the recesses, and the flutes, the rod is held by two screws, on its side, on a bar which is gripped in the machine-vice and set level. The recesses are cut with the same cutter that attends to the top and bottom, and the flutes by a saw-type cutter of requisite width.

As the above process requires a rising-and-falling table to engage the cutter with the work, it can't be done on the usual type of lathe, but the old lamented 4-in. Drummond would have done it. However, I find that it can be done on my latest acquisition, the Myford "supersonic," using the vertical slide and the largest angle-plate. The slide is set so that it overhangs the cross-slide, and can be dropped to its lowest position, and the angle-plate bolted to it as low as possible. The top of the angle-plate then forms a rising-and-falling table, to which the rods can be bolted by a hook bolt, or clamp, at each end; the blanks should, of course, be left long enough to allow this to be done. An end-mill, with side-cutting teeth, is then put in the three-jaw, and the slide run up to it, near enough to allow the end-mill to project over the rod blanks. The end-mill need not be very big; about ½ in. would be plenty. The vertical-slide is then raised, so that the end-mill cuts into the blanks, with its side teeth, to the required depth; and by very slowly traversing the cross-slide, the surplus metal can be removed. Use plenty of cutting oil, and run the lathe slowly. The job can be done in similar fashion on the ML7 or any other lathe with the necessary attachment.

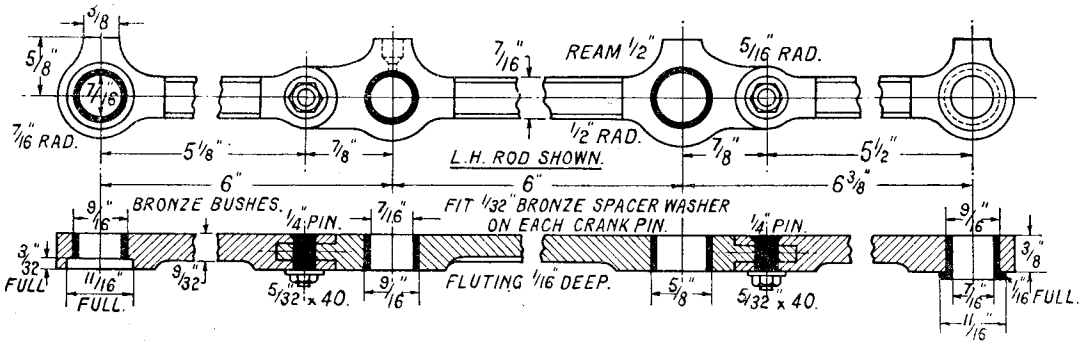
Handicraftsmanship

If no machining methods are available, the job can be done by hand, and very easily at that. Set the marked-out blanks in the bench vice, with the marked line just showing at the jaws. As close as possible to the right-hand boss, file a gap from the top of the blank, down to the line, making it wide enough to take a hacksaw blade on its side. Put a blade sideways in the frame, teeth to your left; and starting from the bottom of the gap, saw along toward the other boss, keeping the blade pressed flat on top of the vice jaws. When you reach the other boss, saw down to meet the horizontal cut, from the top of the blank. Then turn the blank upside down, and repeat operations. Careful application of the humble but indispensable file, will finish the job.

Bosses can be machined in the lathe, by aid of an end-mill as mentioned above. Turn a pip about ¼ in. long, on the end of a bit of ½-in. square bar, or whatever size will suit the lathe toolholder. The pip should be an easy fit in the hole in the boss to be machined. Set the bar crosswise in the rest, parallel with the lathe bed, and put the hole in the end of the coupling-rod blank, over the pip. Adjust position of slide-rest so that the boss to be formed is level with the side teeth of the cutter. Hold the end of the blank very tightly with your left hand, and feed the end on to the cutter, by advancing the cross-slide. Mind it doesn't " snatch " when the teeth start to cut. Now, if you swing the free end of the rod slowly in an arc, the cutter will chew away all the surplus metal, and leave a nicely-rounded boss; but don't swing the rod around far enough to cut off the oil-box. Before I had a



Coupling-rods—3½-in. gauge engine



Coupling-rods—5-in. gauge engine

vertical milling-machine, I used to do all my coupling-rod bosses by that method. At the munition-shop in the Kaiser's war, my girls rounded off thousands of eye-ended rods in exactly the same way; but they had plenty of leverage, as the rods were 14 in. long.

Counterbores, Knuckle Joints, and Bushes

The first and second bosses of the 2½-in. gauge coupling-rods are recessed to a depth of $\frac{1}{16}$ in. full, with an 11/32-in. pin-drill having a $\frac{1}{8}$-in. pilot pin easily home-made, as described many times previously. The knuckle-joints are of the fork-and-tongue pattern, similar to full-sized practice. The shorter rods are forked, and the middle section is tongued at each end. The forks are formed in the same way as I have described umpteen times, for forked joints in valve-gears; clamp the rod at centre-height under the lathe tool-holder, at right angles to the bed, and feed it on to a 3/32-in. saw-type milling-cutter on a stub arbor in the chuck, or a long arbor between centres. Use plenty of cutting oil for a clean slot.

The tongues are formed by pin-drilling each side of the centre section, with a $\frac{3}{8}$-in. pin-drill, until it is reduced to 3/32 in. thickness, an exact fit in the slotted end of the short rod. File away any surplus around the tongue, insert into the slot, and pin as shown in the section. The holes at each side of the fork should be slightly countersunk. The joints should be free, but not slack.

The holes in the first and second bosses should be opened out with a 9/32in. drill, the third with $\frac{5}{16}$-in. drill, and the fourth with $\frac{1}{4}$-in. drill. Bronze bushes should then be fitted to all of them, as shown. Nos. 1 and 2 are a bare $\frac{1}{8}$ in. wide, extending from the bottom of the recesses to the back of the rod. No. 3 is flush with face and back. No. 4 is flush at back, but has a flange $\frac{5}{16}$ in. diameter on the front. These bushes are just simple turning jobs, which need no detailing. They should be a tight press fit in the holes in the bosses. Tip: if you just take off the sharp edge of the drilled hole in each boss, the bushes will press in easily, and stay in. Sharp edges will scrape the bush as it enters, and spoil the press fit. A No. 55 hole for oiling, can be drilled down the centre of each oil-box, and counterbored with a No. 40 drill, as shown by dotted lines.

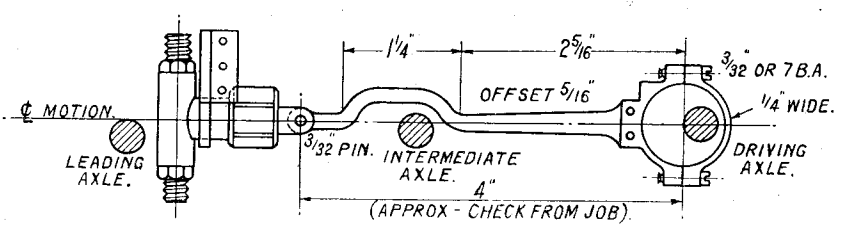
Variations for Larger Sizes

Except for size, the rods for the 3½-in. gauge engine are the same as those for the 2½-in. quin, and can be made in the same way; but there is just one small variation. The first knuckle-joint has a pin countersunk on both sides, but the rear pin is only countersunk on the inner side. It can be turned from $\frac{5}{16}$ in. round steel, held in three-jaw, $\frac{3}{16}$ in. of the end being reduced to $\frac{1}{8}$ in. diameter, and screwed $\frac{1}{8}$ in. or 5 B.A. to take a nut and washer. This is shown in the plan. Mild steel bar of $\frac{7}{8}$ in. × $\frac{1}{4}$ in. section will be needed for the 3½ in. job.

The coupling-rods for the biggest girl of the family can be made from 1⅛-in. × ⅜-in. mild steel. If no milling machine is available, the bulk of the surplus metal can be removed by turning. Cut the pieces of bar long enough to extend about ¼ in. beyond the bosses, square off the ends, and centre them with a centre-drill, on what will be the centre-line of the rods when finished. Mount between centres, with a carrier on the end, and turn away the surplus metal between the bosses, with a round-nose tool, rather pointed (says Pat). Be careful when starting the cut, or the piece will jump out of the centres, or knock the point off the tool. This will naturally leave the top and bottom of the turned part rounded; but careful application of a file will flatten them out, and it's a much easier way of doing the job, than laborious sawing and filing. This size of bar is rather too much to mill on the average home-worker's vertical-slide. Otherwise, the machining and fitting of the bigger rods can be done pretty much the same as the smaller ones, including rounding off the bosses, and slotting and pin-drilling the knuckle-joints. Note that *both* knuckle-pins are furnished with nuts and washers on the outside; we have more room to play about in, on a 5-in. gauge engine.

Another point to note, is that only the leading boss, which passes

(*Continued on page* 263)



Arrangement of pump—2½-in. gauge engine

OSCILLATING PISTONS for ENGINES AND PUMPS

By Arnold Throp, M.I.Mech.E.

THE excellent article by Mr. C. Horace Clarke, "The Simplest Steam Engine?", on page 620 of THE MODEL ENGINEER for November 25th last, showed interesting examples of actual and projected engines with the steam and exhaust functions controlled by ports in the piston and cylinder walls.

I have never seen commercial engines working with this arrangement of ports, but certainly reversed engines (i.e., pumps) have been made incorporating these principles.

In the middle twenties, the once famous steam engine firm of Cole, Marchent & Morley, Ltd. of Bradford, produced a range of small pumps of this kind for a year or two. They were intended, I think, for exhausting chambers in chemical plants, a use to which vacuum pumps are still put, in order to transfer corrosive liquids by atmospheric pressure, without the liquids contacting pump parts. These pumps were made in sizes up to 2½ in. or perhaps 3 in. bore, large enough to allow of drilling the ports through the cylinder walls and pistons near the ends, thereby reducing the clearance volumes to the low value necessary for efficiency in a pump. One unit was actually made with a cylinder 8 in. diameter and about 3 in. stroke. This produced a 22 in. Hg vacuum and moved a lot of air when running around 300 r.p.m. For machines of this size, the driving mechanism had to be capable of absorbing a fair amount of power, and Fig 1. shows the kind of design used.

The disc crank was bored with a deep hole, in which a sliding and rotating pin worked, connecting the crank to the piston. This pin remained parallel with the crankshaft at all positions. In the piston, another pin was inserted, parallel with its axis, and an eye on the crankshaft pin encircled the piston pin. Bronze bushes (not shown) were provided at the rubbing surfaces, and it will be clear from the sketches that it was a simple matter to provide generous bearing surfaces at all contacts, to give low pressures and long bearing life. No spherical surfaces were used, and I think that, even scaled down to model sizes, this design would not be difficult to reproduce.

The firm mentioned did not continue to make these pumps very long, as they went into liquidation in 1928. Various financial and technical difficulties, not uncommon to the managements of that time, brought to an end a concern which for many years had set an extremely high standard of steam engine and power plant construction, so that many of their engines are running today and will probably see this century out. A number of interested people bought up some of the assets, including the drawings, when the effects were sold, and under the title C.M. & M. (1929) Ltd., have been, and in fact still are, servicing the many large engines of the old company driving textile mills, tinplate works, etc., but did not take up the construction of new engines.

The pumps mentioned above were known as Briggs pumps, from, I think, the name of the inventor.

After leaving Cole, Marchent & Morley, I spent about a year as a fitter with The Universal Valve & Chemical Accessories Co. also of Bradford, who not only made the excellent "Bee" governor for steam engines, but also at that time had been making ultra-slow speed metering pumps for the artificial silk industry. Pumps of the five-vane type had been used, but just at the time I went they were machining the parts of a batch of 100 pumps of a new plunger type. These turned out to be a very similar thing to the Briggs pumps, and Mr. Clarke's engine. The pistons were about $\frac{7}{16}$ in. diameter, and the crank mechanism was totally enclosed, with a view to running it in an

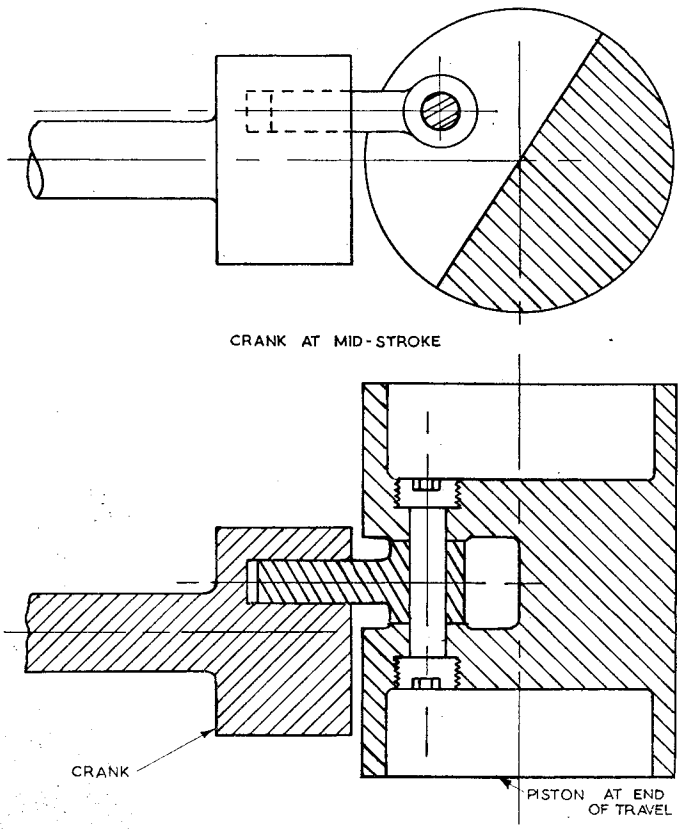


Fig. 1

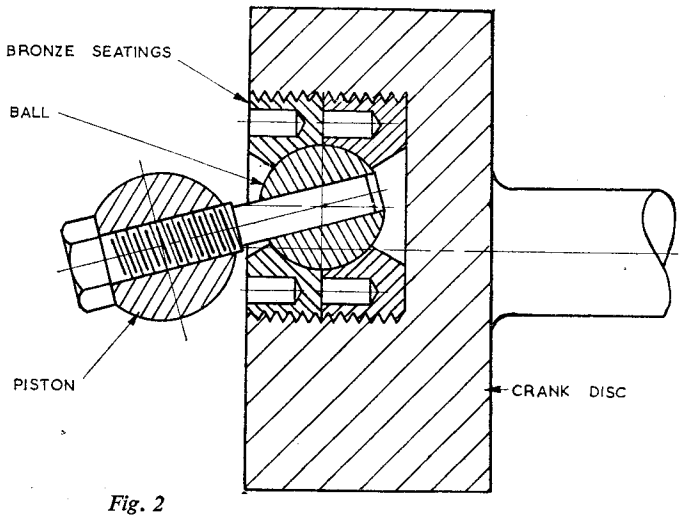


Fig. 2

oil-bath. Fig. 2 shows the construction.

The piston had a tapped transverse hole, in which a heat-treated pin was screwed. In the rather large crank disc was a ball with a hole drilled across its diameter, in which this pin worked. The ball was, in fact, a commercial bearing-ball which had been softened for drilling and re-hardened. It oscillated in carefully profiled seatings of bronze, screwed into the recess in the crank disc. Again it will be seen that all working surfaces had plenty of bearing area, in accordance with good commercial practice. But these pumps did, in fact, give a great deal of trouble and were eventually scrapped in favour of a reversion to the vane pumps.

They were used for pumping a thick gluey liquid through extremely fine nozzles, rather like the rose of a watering can—but much finer—and the liquid emerged under water in a glass tube, the bottom end of which was in a water trough. The liquid had a high ammonia content, which was absorbed by the water, the liquid then coagulating into a series of fine threads, which were twisted together by swirling the water in the tube. The thread passed out of the trough, over rollers, and was wound on spools, being then the yarn from which artificial silk garments were made. The pumps had to give a very uniform rate of delivery, to avoid thick and thin places appearing regularly in the yarn, and were, in fact, only used to control the feed rate of the liquid, which was supplied to them under pressure. There were 100 pumps on each " spinning " machine, driven by gears from a single long shaft, and they turned at four revolutions a minute only ! The vane pumps when in good condition, gave a very steady feed even at this low speed, but the piston pumps were never so good. The simple two-impulse piston was, of course, bound to have two dead points of zero delivery, and considerable variation in other parts of the stroke. This was made up by two spring-loaded pistons, which were pushed back and forth by a two-lobed cam on the crankshaft. The difficulties of producing the hardened cams to the exact shape were very real, as were the problems of cutting the piston and cylinder ports with $\frac{1}{16}$ in. slitting saws, and getting the exact timings of delivery and inlet cut-off.

The cylinders were very long in comparison with the diameter, and although drilled and reamed in a jig, it was not possible to get the two bores co-axial, as the drill pushed off where it crossed the crankcase aperture in the iron casting. A few body castings were scrapped, and many produced a lot of friction when assembled, whilst some were salvaged for a time only, by necking down the pistons for some distance to make them flexible.

Eventually, Nemesis came when the pumps were set to work. If at any time the " spinning " machine had to be stopped for some reason, the liquid in a quite short time set dead hard in all the pumps, and while it had great powers of penetrating into all the working clearances, it had little or no lubricating properties. When it was once set it became a bench job to get a pump to work again. A re-start of the machine simply wrecked the driving mechanism of the pumps. Now the vane pumps, on the other hand, would stand a certain amount of that kind of abuse, their simpler mechanism and more robust drive taking care of the stresses, though I remember stripping quite a few of these that needed new " innards " after an overnight stop.

Anyhow, the piston pumps were soon abandoned—a rather tragic end to a design which had some points of merit and which might well have worked admirably as a simple pump (with the omission of the cam-operated parts) on reasonable fluids, and again given rather better boring of the cylinders.

However, the two methods of crank-to-piston drive which I have illustrated may prove of some interest to any who are inclined to follow Mr. Clarke's example with this very compact type of engine.

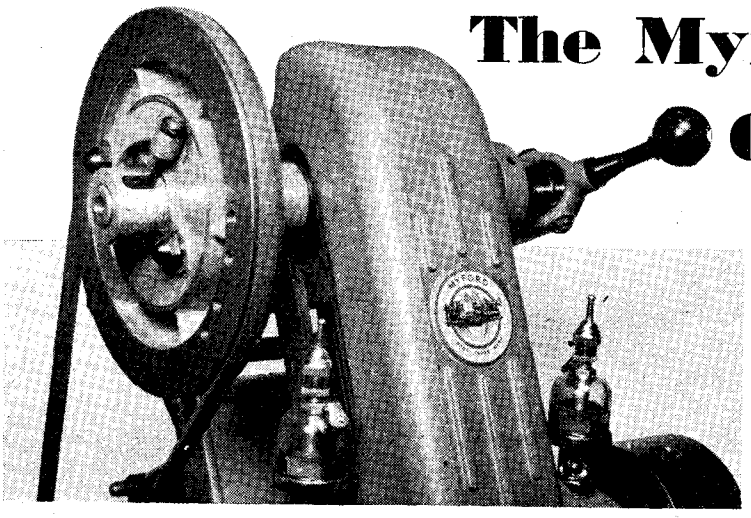
L.B.S.C's "NETTA"

(*Continued from page 261*)

behind the crosshead, will need recessing. If the second one is fitted with a flush bushing, a retaining nut and washer can be fitted without them running foul of the connecting-rod, which is cut away on both sides (as in full-size practice) on the biggest quin. If anybody wants a posh job, they can tap the counterbores at the top of the oil boxes, and fit weeny brass screwed caps, made from hexagon rod. Anybody who hasn't a milling machine, can put the flutes in, by the method described for the gauge " 1 " rods, the rounded ends of the end-milled flutes being chipped square by aid of a home-made chisel, easily ground up from a short bit of silver-steel, and hardened and tempered to dark yellow.

I think that's all there is to say about coupling-rods, and the next stage will be assembling the eccentrics on the driving axle, quartering the wheels and fitting the rods; but as several prospective builders seem rather hazy about how the feed pumps will be erected, to clear the inside valve-gear, I have included an illustration showing the location and layout of the pump for the $2\frac{1}{2}$-in. gauge engine, for their enlightenment. I'll have something more to say about this, when describing how to make the pump.

The Myford M.L.7 Clutch Unit



FOR several years now there has been an increasing tendency to "motorise" small lathes and other machine tools as employed in the amateur workshop, as distinct from both treadle drive and the use of a separate power countershaft. There is no doubt about the convenience of a compact self-contained power unit attached to the machine itself, but most of these units lack any method of disconnecting the motor from the machine spindle, so that the only method of control is by the motor switch. While this serves most normal purposes, and is generally found satisfactory for the requirements of the amateur worker, it has certain disadvantages and limitations.

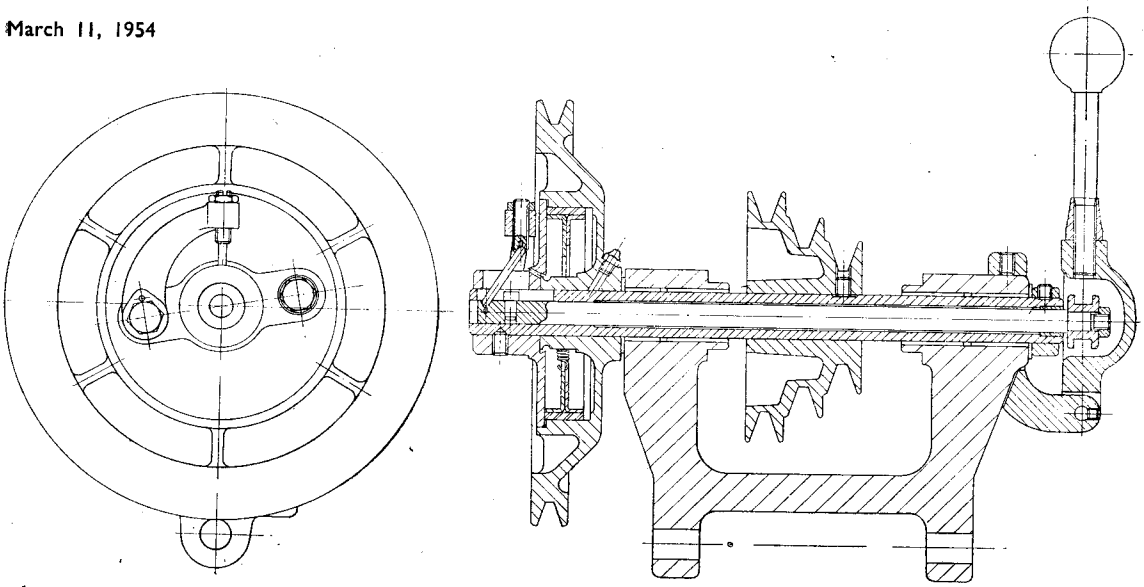
In the first place, the usual type of motor fitted to these machines has a relatively low starting torque and is unsuited to starting up against any appreciable static load; this can be remedied by the use of capacitor-start or other high torque motors, but these are more expensive. Ordinary split-phase induction or "squirrel-cage" motors, having starting windings with automatic cut-out contacts, are almost universally employed, and work satisfactorily so long as the machines are not started "on cut," but control by switch, when repeated stops and starts are made, causes excessive wear and tear of the contacts, not only in the switch itself, but also those of the automatic cut-out in the motor. Frequent switching also increases the temperature of the motor by bringing the starting windings repeatedly into operation. The surge currents on starting up are unduly high, and the opening and closing of contacts may cause interference with neighbouring radio and television receivers; moreover, the method does not permit of the fine control required for "inching" the machine spindle when setting up.

The more elaborate "motorised" machines are usually equipped with a countershaft friction clutch, which enables the motor to start up free of load, and the power to be applied without shock or current surge. Where these facilities are not provided, however, some operators seek to obtain similar results by the use of the belt tension lever, which is effective up to a point, but cannot be recommended as a regular practice, because the modern type of rubber vee-belt is unsuited for working for any length of time under conditions of partial or total slip, which may cause overheating and abnormal wear of both pulleys and belt.

In the popular Myford ML7 lathe, the demand for some form of mechanical control has led to the development of a simple, but very effective friction clutch which can be incorporated in the standard power unit with minimum alteration to the existing arrangements. This clutch has now been on the market long enough for a fair assessment of its qualities; it is used by many readers of this journal, and also in the "M.E." workshop, where it has been given a prolonged test under working conditions. It is undoubtedly a great convenience in facilitating control of the lathe, and perfectly reliable in use.

As seen in the photograph, the main clutch member is incorporated in a special primary drive pulley, identical in rim size to the normal fixed pulley, so that the speed ratio from motor to countershaft is unchanged; this pulley is mounted to run freely on the countershaft, and provided with an oil nipple for lubrication. The clutch is of the internal expanding type, the inner component, which is fixed to the shaft, having friction-faced linings with tension springs, operated by means of a cam, in the same manner as the orthodox vehicle brake. A curved arm on the cam spindle carries at its extremity an adjustable screw, the end of which is socketed to receive a push-rod, which is disposed radially and enters a slot in the hub; these parts may be clearly seen in the illustrations.

The countershaft is the same diameter as the fixed type, and runs in the same bearings in the bracket, but it is hollow, and equipped with an internal rod, capable of endwise movement. At the clutch end, this rod is fitted with a stop-screw to limit its working range, and has a socket to retain the end of the radial push-rod. In its outward position, the latter lies at an oblique angle, which shortens its effective radial length; but as the internal rod is moved inwards, it straightens up the push-rod until it becomes approximately square with the shaft axis. This produces a powerful toggle action, which forces the cam lever outwards, thereby expanding the clutch shoes so that they grip the inside of the drum in the pulley, and thus take up the drive smoothly and gradually. To operate the push-rod, a thrust bearing is provided at the other end of the countershaft, with a gimbal bearing in the operating lever, which is pivoted to a bracket mounted on the countershaft boss. Thrust washers are provided at both ends of the countershaft bearings, but it should be observed that end thrust is present only during the actual operation of clutch control, and under normal working, either when engaged or free, no endwise load whatever is present. The force required to operate the clutch is small, due to the considerable leverage of the operating gear, and adjustment to



take up wear is very easily made by the screw and lock-nut on the arm of the clutch cam; in practice, it appears that the need for readjustment would be very infrequent.

This clutch can be supplied with new lathes, as an extra to standard equipment, or fitted to existing lathes by slight alteration to the existing countershaft bracket. Lathe users wishing to make this conversion are recommended to send the complete countershaft bracket to the Myford works, *with the original countershaft in place* in its bearings, and carefully packed to avoid any possible risk of damage to the bracket casting, as it has been found that this may be liable to distortion, sufficient to affect bearing alignment, if roughly handled in transit. It is also possible to obtain the unit complete with the bracket, ready for fitting, and thus avoid putting the lathe temporarily out of commission. The fitting of the clutch unit does not interfere with the use of the standard belt guard, but a slight alteration of the inner rim of the guard is necessary. The general working principle of this clutch is similar to that fitted as standard to the Myford "Super 7" lathe, but neither the complete unit nor its components are interchangeable with those of the latter type. Full instructions for the fitting and adjustment of the clutch unit are supplied by the makers.

The Allchin "M.E." Traction Engine

(*Continued from page* 258)

three or four toolmaker's clamps or what-have-you on the rings, to press them close together—an important point, that; there must be no gap showing between the tee-rings when the wheels are finished. Grip one of the *first* strakes to the second ring with a small clamp, and drill the end hole through both. Countersink slightly on the inside, and rivet as before.

Next, do the one a third of the way round, following up with another a third of the way round, which leaves the rings secured together in three places. Check the position of the bolted-on strakes on the second ring, and then clamp, drill, and rivet three of these to the first ring, which secures the two in six places, of course.

From now on, it is a case of clamp, drill, and rivet, working in threes, so to speak, until all the rivets in the outer rows, and then all those in the inner rows, are fixed. The screws and nuts will be removed as you proceed, and the rim begins to look "something like," with half the strakes riveted on.

Riveting the others is easy, one at a time. Hold the strake in place with a clamp at each end, drill the four holes through, and rivet 'em up. All this sounds like a lot of riveting, but, as I've said before, it's surprising how fast you can get on, with the tools properly laid out to hand. It certainly isn't a job to be afraid of—and when you see those rows of rivets, all neat and tidy, you'll get quite a kick out of it! I know I did. You can then drill all the $\frac{1}{8}$-in. holes through the rims, and countersink very slightly on the inside.

More Drawings Ready

And now I have some good news for the lads who are working ahead of the serial; another sheet of drawings is ready.

It gives the general arrangement of the cylinder and valve-gear, and further includes *details* of the cylinder and valve-chest, and flywheel. Another sheet of details of the motion is well in hand, and *may* be ready by the time this appears in print, but of this I cannot be certain.

Incidentally, I must acknowledge, with many thanks, the kindness of "L.B.S.C.," who has "vetted" and approved the valve-gear of the engine. I had no reason to doubt the efficacy of my arrangements, but as this is my first published effort in this particular field of design, I thought, maybe, some builders would be happier to know that our old friend had cast his eagle eye over it. So many thanks, Curly, we all appreciate it greatly.

Castings

At the time of writing, Brer Reeves has the matter of cylinder castings in hand, so these, too, may well be ready when this article appears in print, unless some snags arise meanwhile.

Talking of castings, by the way, he has just sent me some of the hind-wheel hub-caps, with the lettering cast on as in the prototype. They certainly look good, and will add a nice touch of authenticity to the appearance of the finished model.

(*To be continued*)

QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Compression-ignition Engines

Please inform me of any firms who can supply 2.5 or 5 c.c. marine-type compression-ignition engines of fairly low r.p.m., together with gearboxes for twin screws, stern tubes, propeller shafts and propellers.

G.C.M. (Alverstoke).

Marine-type compression-ignition engines of 2.5 to 5 c.c. are unsuitable for working at low r.p.m., as they must necessarily be made of high compression ratio, and can only work efficiently with a fairly high piston speed.

Electronic Developments (Surrey) Ltd., 18, Villiers Road, Kingston-on-Thames, Surrey manufacture 2.5 c.c. compression-ignition engines designed specially for marine work, also stern tubes, propeller shafts and propellers, but there are no gearboxes available for such engines so far as we are aware, and they are usually direct-coupled to the propeller shafts.

Petrol Resisting Paint

Where can I obtain a small amount of paint that will resist heat and petrol and is suitable for model work? I do not wish to use cellulose paint.

J. A. (Barnardiston).

Most of the synthetic or phenol base enamels will resist ordinary petrol, though not necessarily the solvents which are used as additives to modern fuels.

A great deal will depend on how the paint is applied, and some of these enamels require special stoving or other treatment.

With reference to heat resistance, any paint which is properly applied in relatively thin layers will resist a fair amount of heat, but for special heat-resisting properties, it is desirable to use paints which have been stoved at fairly high temperatures.

We suggest that you might be able to obtain suitable paint for your purpose from the following firms: Jenson & Nicholson Ltd., Goswell Works, Stratford, London, E.15. Pinchin Johnson Ltd., 4, Carlton Gardens, London, S.W.1.

Plans for Tugs

Having seen the photograph of that magnificent model tug "Chieftain" on the cover of the December 24th, 1953, issue, I am contemplating building one on similar lines, and would be very grateful if you could furnish the main dimensions for the hull and superstructure. Should you, however, have drawings already existing in your plans dept., perhaps you will let me know.

W.J.M. (Shoreham-by-Sea).

We regret we have no drawing of the tug *Chieftain*. We have, however, two tugs in our plans list (a copy of which may be had post free on application), one P.B.3, being more or less similar to that on our cover, and the other, P.B.10, the model of an ocean-going salvage tug, which is a much larger prototype. You would find either of these designs very helpful.

Re-sharpening Engraving Tools

I have been attempting to re-sharpen some cutters for a machine engraver of the type that employs a belt-driven spindle on a pantograph arm, but cannot get them to cut properly. The cutters are in the form of a D-bit with a fine point at an angle of about 60 deg. I have tried honing both the semi-circular and flat faces. Should these cutters be backed off or relieved in any way?

A.W. (Ashford, Kent).

Engraving cutters for fine work must be ground and mounted absolutely truly so that the tip coincides exactly with the axis of rotation. If the flat face of the cutter has been correctly ground in the first place, any subsequent re-grinding or honing of this face will make it eccentric to the axis, so that re-sharpening should be done on the semi-circular face, but hand-honing is not likely to be satisfactory. It should be done by the aid of a circular grinding fixture, in which the cutter is mounted perfectly truly to preserve concentric precision of running. These cutters are not usually backed off, and, therefore, have no cutting clearance, so that it is essential to keep them sharp and properly set to produce good results.

Tempering Tool Steel

I have been trying to harden and temper some old chisels, but have failed to get satisfactory results. Several methods have been tried, including straight quenching in water and oil, and tempering by reheating and watching the colours run, then requenching at colours varying from dark straw to purple. Where have I gone wrong?

H.J. (Darlaston).

The tempering of carbon tool-steel by colour indication, while fairly reliable in a general way, where the composition and quality of the steel are known, is not invariably applicable, especially in the case of certain types of carbon or alloy steels which have been used for chisels and other tools. The colours are not *in themselves* an indication of the hardness of the steel, but are produced by surface oxidation, and the colour actually indicates the thickness of the submicroscopic oxide film. Indirectly, it may be a more or less reliable guide to temperature also, but this will be influenced by the resistance of the particular steel to corrosion, and may, therefore be very misleading in the case of alloy steels. Unhardened steel, or steel that is not capable of being hardened at all, will also be subject to colour changes on heating. Old chisels, which have been re-hardened and tempered several times, may become more or less "denatured" by having much of the carbon burnt out of them, and heating to an excessive temperature at any time will alter the crystalline structure of the steel so as to make it useless for cutting tools. We advise that carbon steel tools should never be heated above a medium red heat, and quenched at the extreme tip only in clean cold water, after which a test should be made to ensure that they are really hard, by attempting to scratch the edge with a file. If the result is satisfactory, they should be ground, or polished with emery, to show a clear metal surface, and heat applied an inch or so away from the tip, till the colours run and produce the appropriate indication at the tip, then re-quenched immediately.

From Scrap ....to Track

By E. G. Uphill

IT might well be stated that this engine started as bits and pieces from the scrap-box. To start somewhere near the beginning, which is usual, somebody's mother wrote me saying she had a lot of model engines and parts left by her son, and as she would like them to fall into the hands of someone who would appreciate them, would I come and make an offer for the lot? I had momentary visions of a small science museum for sale, but did not build up any hopes, as then I could not be disappointed. Eventually, I went to inspect the articles in question and found them to comprise several pounds of short ends of brass and copper rod, two or three heavy lumps of rusty iron, a pair of partly-finished and assembled frames for a 4-6-2 wide-firebox tender engine, a set of six 5-in. driving wheels, one of which was faced up on the inside and drilled ⅜ in. through the centre, all very rusty, and a tobacco tin containing three drills, three taps, two used matchsticks and a ball-bearing!

To cut a long story short, I sold most of the brass for scrap and retrieved the cash spent for the lot and added the taps and drills to my collection. Now what was to be done with the frames and wheels? Being a member (fully paid up) of the Harrow & Wembley Society of Model Engineers. (I'm glad I got that in, nice free advert for the club, if the gent with the blue pencil does not get to work on it. I hope he does not, because there has been enough blue pencil used up on this engine already, though I suppose its all good for the blue pencil industry.)

Now, where was I? Oh yes; the club hold what they call a rummage, or junk sale once a year, when members bring along their junk and the whole weird and wonderful collection is sold by auction in lots. This, I thought, was my opportunity to get rid of my frames and wheels but—No, sir, not on your life! And, although I would have been glad to let them go for the magnificent sum of twelve copper coins of the realm, they did not even fetch a bid. So I had to take them home again. It was then decided that, one day, I would make another engine using these wheels; but the frames were a real nuisance, so one evening I sat on a box in the workshop and took them to pieces. I had just taken out the last screw when the door opened and a club member was ushered in. Could he have those old frames I had put in the junk sale?

Could he have them? He jolly well could; so he sat down and put them together again and went on his way rejoicing. That was my good deed for the day!

A little later on, when the garden and allotment was a-growing and a-blowing, I was stuck for a job. Being one of those merchants who cannot sit still for more than five minutes at a time, I went into the workshop, picked up three of the wheels and laid them on a large plank of wood spaced about seven inches apart, picked up my blue pencil and drew a cylinder just where I though it ought to be, a bogie wheel in front and another one behind. Buffer beams, smoke-box, boiler, tanks, etc., were added all much the same as you see in the photograph. I was just putting the finishing strokes on the board when who should arrive but a very great friend, also a club member, who by the way is making a 5-in. gauge "Halton" tank engine, the tolerances of which are plus or minus three O's nought!

"Ah, just the bloke I want to see," I remarked; "come right in and what do you think of that for an engine?" pointing to the plank of wood. "Looks all right, don't you think?"

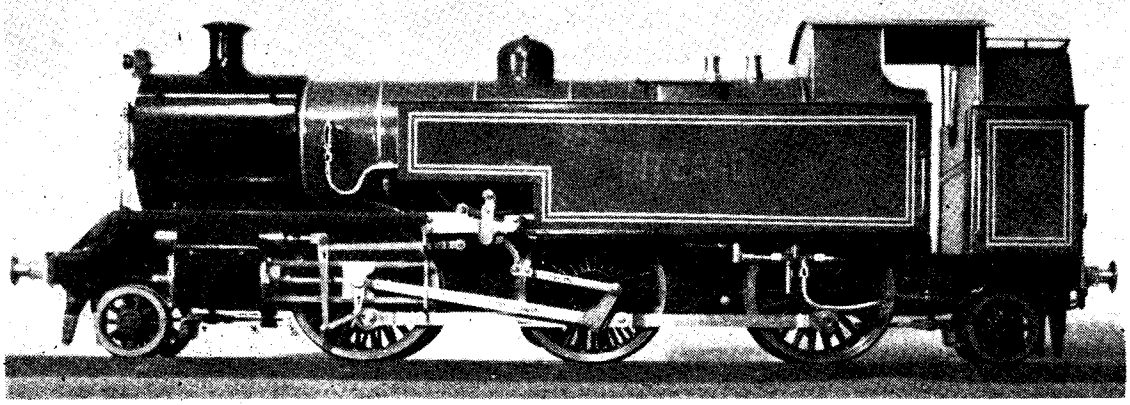
"Well, not bad," he said rather doubtfully, "you going to make it?"

"Well, that was the idea," I answered.

"You'll have to get some drawings out for it," he remarked, being a bit of a draughtsman himself.

"Drawings?" I fired back, "what the policeman do you think these are?"

He looked at me in a very old-fashioned way, and I looked at him. Little did he know, that I knew just what he was thinking about me, and little did he know that I was thinking just the same about him. Three O's nought, indeed! I don't believe there's any such measurement!



He broke the silence, saying: "What about the valve-gear?"

"That's all right," I grinned, "I'll put Baker gear on it; I have the drawings for that."

"What about the back set?" he grinned back.

"Back set?" I said. "What's that when its at home?"

"You'll learn," he laughed; "you have to find out what that is."

"I'll get over that when I come to it, then," I laughed back.

That started the ball rolling. I searched the workshop and found some steel for the frames, and the engine was started. When these were finished with all the bits and pieces that go with them, the wheels were turned and then drilled to receive the crankpins suitable for two-inch stroke cylinders. This I found later was a mistake, but now the engine is finished, and all the snags have been overcome, I am not so sure that it was a mistake. The trouble was I could not find any two-inch stroke cylinders in the scrap, nor could I purchase any. Being reluctant to make patterns, I purchased standard 1¾ in. stroke castings, faced them up one end and silver-soldered on a piece of ¼ in. thick brass. The ports were cut for a standard 1¾ in. stroke job, and everything was merry and bright. The frames had been painted red and black as the work proceeded. The cylinders were fitted, the Baker gear unit was made and fitted, coupling-rods, connecting-rods; the return crank was from the drawings for a 1¾-in. stroke engine, but ⅛ in. was added to this measurement to allow for the extra stroke, and another 1/32 in. was added just for luck. All that remained to do was to join the gear connecting-rod to the return crank, the combination lever to the union-link and valve, and join up the valve-rod to the gear. All these last items were only temporary pieces of mild-steel.

The idea was to get the left side of the gear right and then make the right side to match the left, if you understand what I mean. When all was connected up, the wheels were slowly revolved and the result very carefully noted. Oh, what a mess to be sure! For three whole week-ends, I fiddled with this gear and, at the end of that time, the gear was somewhere near the mark.

I then took the engine to the club one meeting night and let the lads pick it to pieces. It was agreed that all was well except that it would not notch up properly. When I returned it to the workshop, I said to my son who, by the way, is making a 2-6-2 tank engine in 5-in. gauge, also with tolerances plus or minus three O's nought, "What is back set in a gear?"

"Back set?" he mumbled, never looking up from the stay he was screwing in his boiler; "Why, it's back set."

"Yes, I know that," I fired back; "but what is it?"

"Well, that's what it is," he mumbled again, "just back set."'

I could see I was not going to get much help from this direction, when he handed me a book, and said: "There you are, read all about it."

I took the book and read all about it. I decided, there and then, that this engine was going to have no back set. Soon after this, I discovered that by filing away certain parts of the reversing yokes to give more swing was a great advantage and, after fiddling around for two more weekends, I managed to get the gear pretty well right. Although there is nothing perfect in this world, this valve-gear is not far from it.

The gear now finished, we could fire away with the saddle, smokebox and door, all made from 16-g. mild-steel. The chimney was made from a piece of ¾-in. gas pipe with the thread left on one end. A socket was then cut into three pieces; one piece was the rim, one piece the base; after being filed to fit, the smokebox was screwed home leaving half-an-inch of thread through, then brazed up and turned up to shape. A piece of tube was welded to the other part of the socket, belled out, and secures the chimney in position.

Up to now, the only purchases were the cylinders and bogie-wheels; but, as one cannot make a boiler from scrap, the time had come to break open the money-box. The boiler was made from sheet copper throughout, to the "words and music," with the exception of the stays which are ⅛-in. rivets silver-soldered in. The boiler fittings are also "L.B.S.C." with the exception of the regulator, which is the usual disc-type, but is only one inch long and goes in through the dome instead of through the backhead, doing away with the ¾-in. hole. The whole lot was tested to 250 lb. per sq. in.

The tanks were made by a strip of brass to the shape of the bottom and sides; the side plates were then clamped over and short pieces of brass angle placed inside, every two inches or so apart, and the whole lot sweated up with the blowpipe. Both tanks were made in one evening. One was then fitted with a hand-pump.

The next item on the programme was the steam trial. The engine was jacked up on two bricks; all the necessary preliminaries were attended to and steam was raised. When the regulator was opened, steam seemed to come from every-where, but there was no sign of life anywhere! This was, to say the least, very disappointing, and, in the end, the fire was dropped.

My son, who had stopped work on the 2-6-2 and joined me to see the fun, then opened the smokebox door and looked inside. "I expect it would make a lot of difference if you connected the pipe from the superheater on to the pipe leading to the cylinders," he said, just as though he knew all about engines. Of course, he knows more than I do, but I do not let him know that.

However, the operation was soon carried out, steam was raised again, and true enough, it *did* make a lot of difference! Everything was working according to plan. The lubricator was pumping oil, axle pump was filling the boiler, with plenty to spare, safety-valves were blowing off at 80 lb., she notched up nearly to middle and went just as well in reverse.

The following Sunday it was taken to the club's track for a real test, which it passed with much satisfaction with the exception of the lubricator. I have heard the story of the centipede with one wooden leg, but all the ratchet wheels I have always have one bad tooth!

However, this fault was rectified in the end, and during the remainder of the season quite a number of club members have driven the engine, with no unfavourable comments. And, believe me, if they could find fault they would not keep it to themselves.

The cab, coal bunker-cum-water-tank for the injector were made and fitted and painted five coats of green paint. The gold lining was done with transfers, the name in red. The engine is 2 ft. 11 in. long and 11 in. high, and is 3½ in. gauge. It was named *Bitzand*, because it was made chiefly from bits and pieces. It took 13 months of spare time to build, including two months when I was unable to do any work on it owing to pressure of business.

During all this time, my wife had been very tolerant, bringing down many cups of tea, and even suggesting that I have my bed brought down to the workshop, a suggestion I always declined to accept with many thanks, and suggest that I take the workshop up to the bedroom!

Notes on LATHE DESIGN

By "G.E.S."

ALTHOUGH many articles have been written about small lathes and many ideas suggested for model engineers' lathes, there is little information available as to those principles and proportions which make for success in lathe design. Out of a long experience and much research the following data have been obtained. These, wisely used, will produce a sound design for any ordinary sliding and surfacing lathe whether of 1½ in. centres or of 9 in. centres—the same proportions will answer in all cases. It would be a fascinating exercise to make a 1⅝ in. or 1¾ in. centre lathe for tiny jobs.

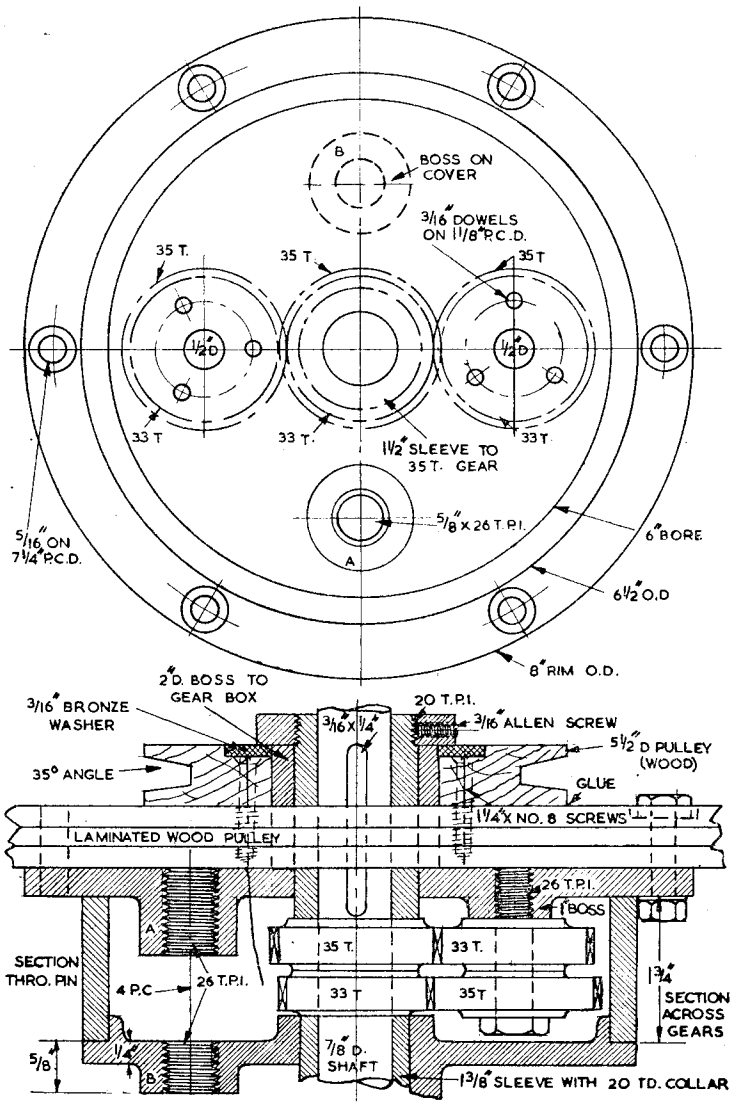
The proportions are worked from the centre height, thus allowing for a design of any centre height. Where awkward fractional figures are obtained, these may be brought up to the nearest standard fraction above. C.H. equals centre height.

(1) Bed sizes: *Width*, minimum, 1½ × C.H. If possible, the distance from the centre line to the front edge should be equal to the centre height, if not 2/3 of the width should be in front of centre line. *Height*, minimum, 1¼ × C.H. with feet extra or flat base and feet bolted on. *Shear thickness*, at least ⅛ × C.H. or $\frac{3}{16}$ × C.H. for small lathes The front shear should be of rectangular section and narrow in width. The back shear should be from one third to three eighths of the total width, and is best with two 60 deg. (or 55 deg.) edges. The centre line of the lathe can be the front line of this shear, on which the tailstock is wholly carried. The drawing illustrates one idea embodying this.

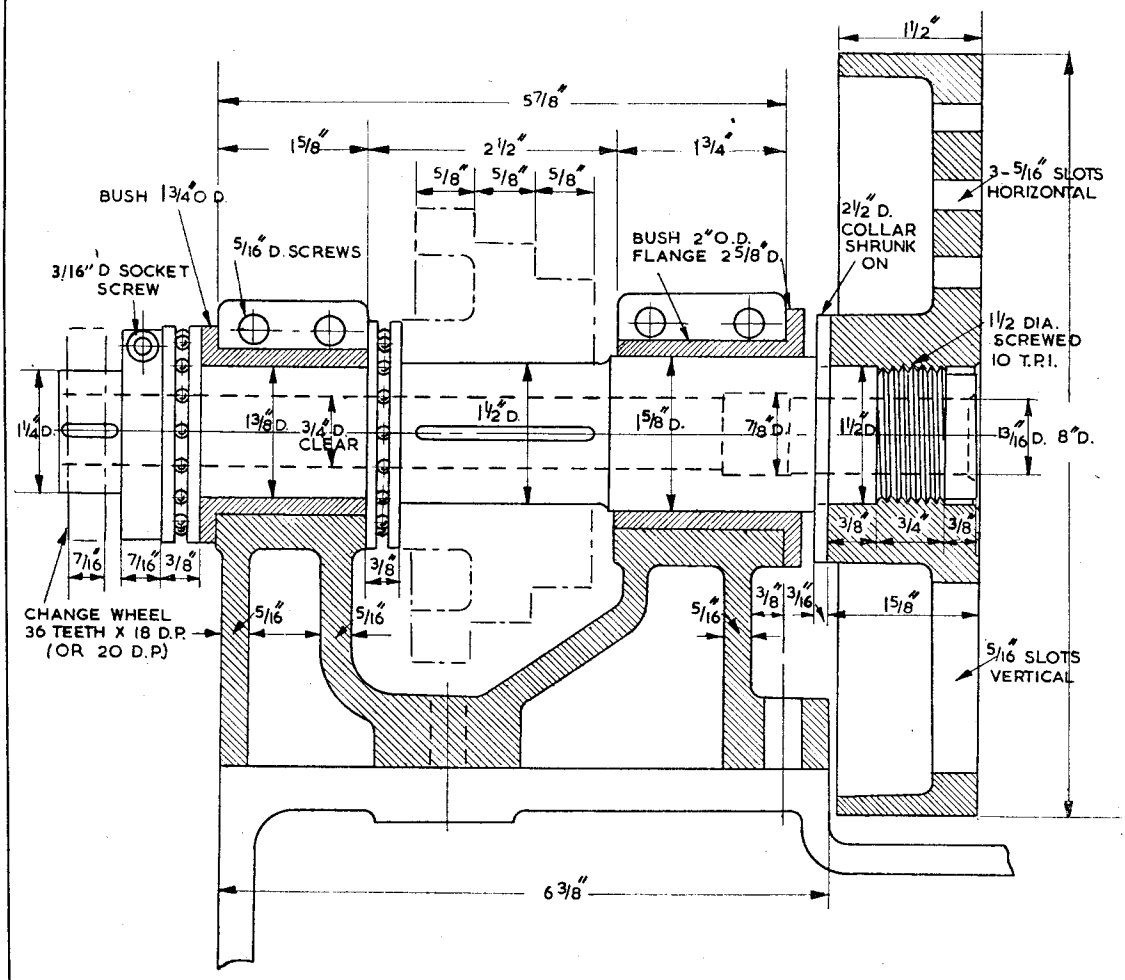
The bed casting should be of box section, as this can be designed with no loose strips, and only one draw-off core piece. A bed of 150 pounds weight was successfully cast in this way. Quite thin metal can be used, if great care is taken to avoid sudden changes of section (see drawing).

(2) The headstock. This is a simple one-piece half box casting. The bearings are high duty cast-iron, finished to a high degree with "Widia" or "Wimet" tools, and hand lapped to fit. Proportions: Front bearing, 4/10 of C.H. and half the centre height in length; tail bearing, ⅝ of C.H. and with length, ½ to ⅝ of C.H. The pulley bearing is some standard size in between these sizes, and the nose of the mandrel is equal to main bearing, or larger, according to collets fitted. The mandrel should be of at least 30-ton tensile steel. Finish to the mandrel can be either fine turned and lapped, or turned and ground, but in the latter case some slight lapping must be allowed for, to give the necessary precision fit.

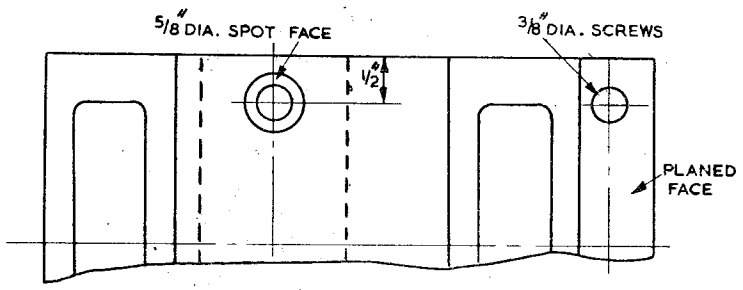
Tailstock. This is a simple casting, which may be any one of several shapes. As drawn, it is an easy matter to cast and machine, without



Back Gear (Epicyclic type)



Sectional elevation of lathe headstock based on data contained in the article



Part plan of headstock base

elaborate patterns or complicated machining operations. The barrel is fully floating, as the nut and screw are inside the barrel. Proportions—the barrel should be at least $1\frac{1}{2}$ × the diameter of the centre fitted and have a travel equal to the normal length of a standard $\frac{3}{8}$ in. drill ($4\frac{1}{2}$ in.) in sizes up to $4\frac{1}{2}$ in. lathe, and equal to the normal length of a $\frac{5}{8}$-in. drill ($5\frac{1}{2}$ in.) in sizes above. The loose base makes for ease of fitting, and gives a desirable accessory, even if not used frequently.

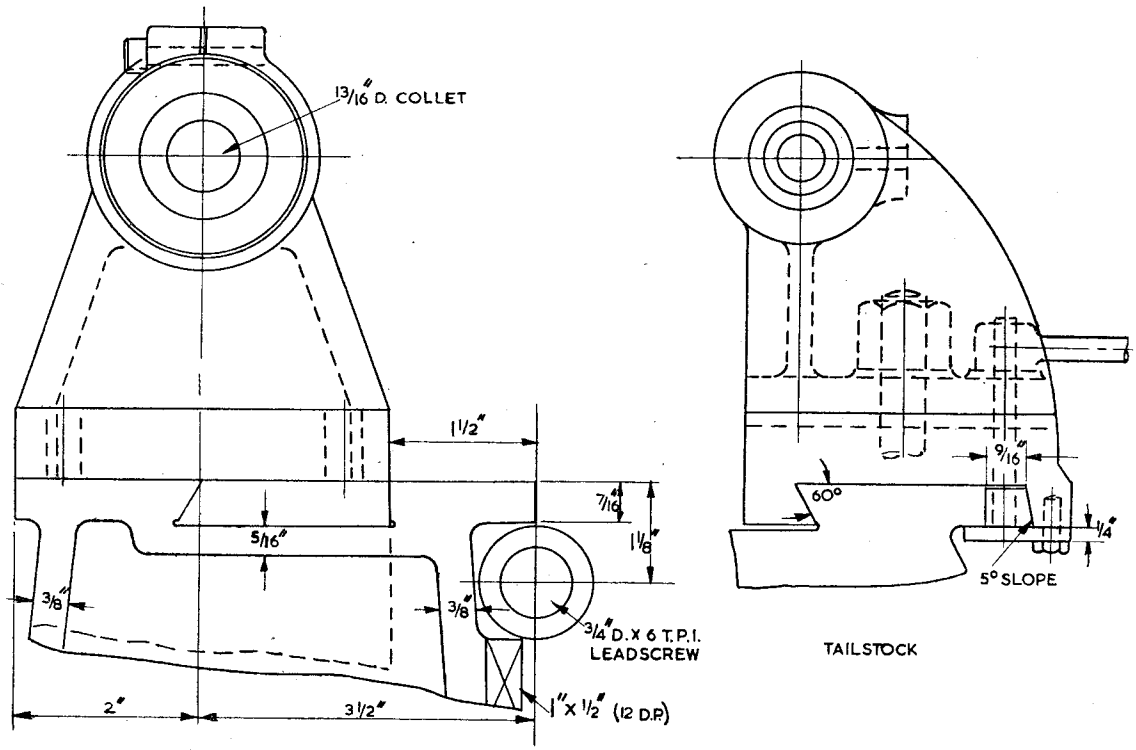
ment, with simple parallel gibs fitted to the vees. These, though a little more difficult to machine are easier to fit, also definitely easier to measure for parallelism, and alignment to the mandrel.

Whether an apron is fitted depends on the desires of the users. In practice, it is vital that if one is fitted, there should be a separate leadscrew and tail shaft; *not*, as so often done, a combined tail shaft and leadscrew. Where no screw-cutting is contemplated, a simple apron with cross and sliding traverses

later on. All that is required as a basis for calculation is the highest speed and the lowest speed required (worked from the largest diameter to be worked and the smallest ditto). There are standards available in table form, but in cases of special nature, the formula is :

$$R = \sqrt[n-1]{\frac{b}{a}}$$

R = Ratio required.
n = The number of speeds required.
a = Lowest speed.
b = Highest speed.



Saddle. This should be well proportioned, the main dimension is the length of the front guide strip, which should be $1\frac{1}{2}$ times the bed width. The various sections of the saddle should be carefully worked out so that no sudden changes occur. The basic design of the saddle depends on the work to be done, but for small engineering, where a table is desired, a cross length should be allowed for, sufficient to give cross travel of twice the centre height. The width of cross shears = $2\frac{1}{2}$ in. to $3\frac{1}{2}$ in. according to centre height. In the design of both cross-slide and top-slide, square shears should take the thrust, and vee shears act as adjust-

is practical, with a $\frac{3}{8}$ in. vee-belt drive in lieu of gears—an obvious saving.

The speeds of a small lathe are of vital importance, and for model engineering, 12 speeds are really desirable. These should not be a matter of compromise nor of convenience, as is so often the case, but should follow a standard law as in larger machines. This law is a matter of simple mathematics—each speed after the first (starting from the highest speed) should be equal to not more than 75 per cent. the previous speed, i.e.: 1,000 r.p.m. first speed; second speed, 750 r.p.m. and so on. This will be demonstrated in an actual set of speeds

This formula can be written and worked as follows :

$$Log\ R = \frac{Log\ b - Log\ a}{n - 1}$$

In actual practice, the figure given would involve too many changes for the range desired in small engineering, so up to 66 per cent. is used to give few changes. The drive to give these can be an all vee-belt drive in small sizes of lathes, and a vee-belt drive with epicyclic gear for lower speeds in larger lathes. This gear is housed in the countershaft pulley, out of the way, but handy to throw into gear if wanted, (see drawing).

(*To be continued*)

TWIN SISTERS

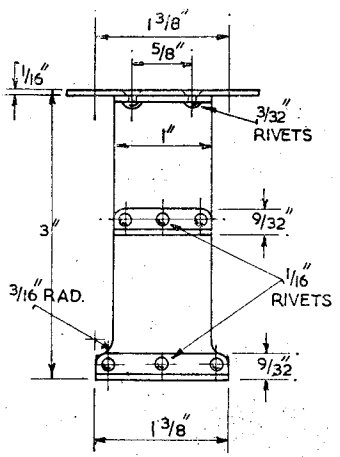
by J. I. AUSTEN-WALTON

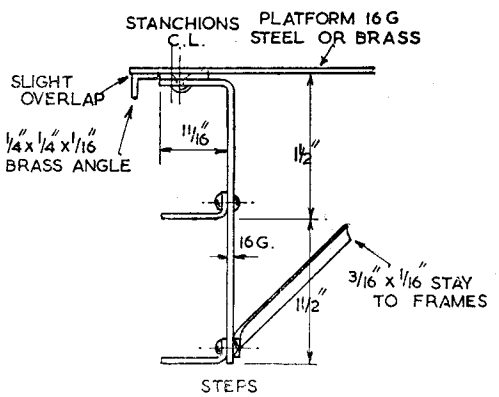
ACTUALLY there are no small fittings to go on the platforms, other than the lamp brackets on each side. The position of these was given on the drawing in the last instalment, but whilst we are working on this part, we may as well deal with the steps and stanchions that are fitted to the platforms.

There are steps only at the back, one on each side, and serving the cab entrance. At one time there was another step on the front buffer beam, and more or less a counterpart of the one on the rear beam, but from what I have been able to gather, this was removed from some of the engines because it got in the way, or somehow was a nuisance. The steps as shown, are, of course, essential and are of simple construction. The step frame is a single piece of metal, 16-gauge steel for preference, bent over at the top to form a deep flange; this, in turn, is riveted to a false plate of the same gauge, with the rivets finished flush on top. The fixing is by two holes in the false plate, drilled to correspond with two holes drilled in the platform, through which the bases of the stanchions are bolted.

The steps are simple bent brackets, riveted in place and with one rivet hole left blank at the bottom to take an 8-B.A. bolt for the stay back to the frames; you will find a suitable spot on the frames on one of the drop corners conveniently left blank. Don't miss out the stay; I have handled many engines where this apparently unimportant item has been omitted, and every time the locomotive was put away the steps have been bent back or forward until they have become both loose and unsightly. The step faces are not shown on the drawing, but one might expect some sort of prepared surface such as dimpling or chequer effect, to do full justice to the job. It is usual to find some sort of "upset" surface on steps for very obvious reasons, and the types of foot-grips vary quite a lot. I used to believe that the sunk-in diamond, or embossed chequer-plate was the only correct style, and I knew of many folk who went to great pains to secure this type of finish by devious means. Some cast brass or typemetal plates off a "positive", and then riveted them in place, a tedious job for such a small detail.

Wandering round the Brighton yard one day, I was surprised to see some machined chequer steps fitted to a tank engine, and I used this form, in stainless-steel, for all *Centaur's* steps. But there is still another type which, when examined closely, looks as though somebody has got busy with a very blunt centre punch. In some examples, a more or less fixed pattern has been followed and does not look too bad; on some others, the foot-grip-perpetrator has allowed his artistic sense to come into play, and the result has been individualistic if not orderly. I like the look of the neatly dimpled step, and having, in the past, stretched my length on slippery chequer plating in other forms of boiler houses, more than once, my respect for the practical grip of the dimple is well established. I went to quite a lot of trouble with my own "Twin" in this respect, drilling countless holes in neat rows in each step plate, later filling the holes with ordinary domestic pins (brass), and sweating them in place with soft-solder. The pin shanks were then removed and the bottom of the plate filed clean and flush. When painted dull black, they looked excellent.





Continued from page 203, February 25, 1954.

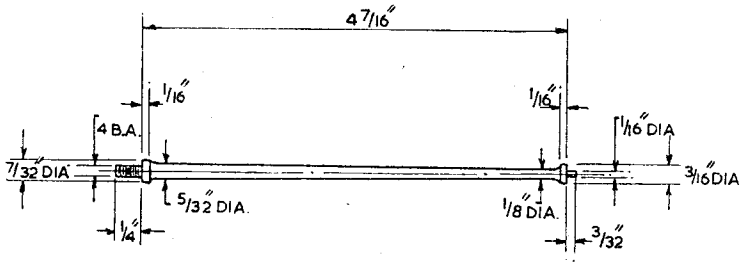
The Stanchions

So far as correct looks are concerned, one cannot be too fussy about the right form for these. Nothing but the fine tapering columns will lift the locomotive out of the "toy" class, in my opinion; and even if these are made in stainless-steel, there is nothing that one might call formidable about it. It is better to do the long slender "turning" with a file, if you are unable to cope with it in the orthodox way, in order to achieve the desired result.

The top of the stanchion finishes in a small plain spigot, and *not* a thread; this allows the side tanks to be lifted off when necessary, leaving the stanchions standing in place. The small spigot fits into a corresponding hole in the underside of the tank capping rail, and everything is quite secure and steady when the tanks and bunker are in place.

About Details

Now that we are getting to the closing stages where details are more in evidence than anything else, I feel it is more than ever my duty to reach a general understanding with my readers regarding the virtues



Stanchion.—4 *off in stainless-steel* (*or mild-steel*)

or otherwise, of correct and full detailing.

It is just as wrong to decry the lack of detail as to deplore its inclusion. We happen to belong to that happy band of people, who can please themselves from beginning to end; and there, indeed, it might end if it were not for that evergreen and vexed question of "Exhibition standards." It must be more than obvious that our taste in locomotive construction is wide and limitless. Take the beginner, for instance; working entirely in the dark, he wants a fairly simple job—moderately free from complications and superfluous details, but capable of hauling him down the garden. This man is pretty well catered for, and one has only to turn back the pages of THE MODEL ENGINEER for the last twenty years or so, and a wide variety of locomotives of all types and gauges will be found. Going from the beginner to the more experienced builder, who also has a building appetite to be satisfied, a sturdy and efficient working locomotive is the principal need; but in this class, it is usual to find the first division of opinion. One man cares nothing for the purely ornamental details surrounding his type of locomotive, whilst the next man considers himself cheated if the finished job does not conform at least in the main or obvious details.

Then comes the "free-lancer" who, as a rule, considers he has acquired enough locomotive knowledge to enable him to spring a new and revolutionary type of locomotive on an unsuspecting world, and a slightly startled exhibition judge a little later on. There is another type of free-lance builder who produces the unorthodox locomotive, or parts of a locomotive, purely for experimental purposes, and, in all probability, few people outside his own circle of friends ever know anything about it.

From there on, the picture becomes more complex and varied, culminating in that specialist type of locomotive akin to the famous *Como* and a few others. There is a forlorn sadness about the few examples in this class, born of years of work, patience and skill, but attaining locomotive immortality that will see all other examples cast aside as rusty relics.

The End or the Beginning ?

However we approach the problem, the ultimate goal must be perfection; not that we shall ever reach it, but that doesn't matter. The focal point is the small locomotive, and as far as I am concerned, each locomotive must be better and more complete than the last, for that is the only true road *towards* perfection.

Unfortunately, this road is not a straight and clear path; there are obstacles, in the way and unluckily, some of these refuse to be pushed aside or disturbed in any way; and all the time, the rules of the game have to be obeyed. There is a limit to the scaling of certain aspects of nature in the field of physics, I think we know most of these limitations by now. There is a limit to the size of opening into which we can persuade our fingers to go, as anyone who has tried to put a 10-B.A. nut on a thread somewhere inside a locomotive's interior, will tell you; *but we have not reached the limit of man's ingenuity, by any manner of means.* We see today, *working* locomotive details that, scarcely ten years ago, were considered to be difficult to make in *dummy* form ! We have materials and finishing paints that would have been the envy of the old hands in their hey-day.

Let us face it, and introduce realism to common-sense. We know how to produce a truly efficient small locomotive, not as a freak or chance effort, but as a machine that will withstand long hard service, and an astonishing record for reliability. We shall go on, of course, making even more improvements and achieving even greater efficiency, with men from many sources contributing to it. In my view, realism will keep pace with all these practical advances, and we shall see every part of the small locomotive coming into being as a working unit.

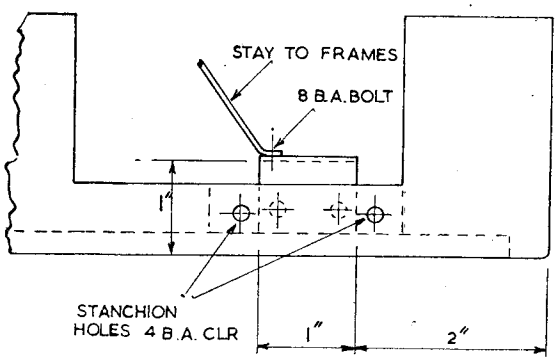
The original limitations will continue to bother us, and will probably defy all our effort to overcome them, but we can set to work with a very clear picture of the little locomotive as nearly perfect as it is possible for man to turn out.

A Good Starting Point

A small locomotive that in any way attempts to take the road to perfection, must take heed of these basic essentials :

The boiler must be safe and sound under all conditions of working, even in unskilled hands. The locomotive must conform to the accepted standards of scale and proportions operating in its suggested country of origin. The materials used in its construction must be suitable and with full regard for the duty the parts have to perform. The cab and other steam fittings should be accurately made, *without sacrificing working efficiency or their ability to withstand reasonable usage.* All working fittings in the cab or other control points, should be readily accessible and, if possible, in their right positions. Painted parts should be duly painted, with full regard to correct colours. Metal finishes should correspond to the normal degree of finish found in the equivalent prototype, and with over-finish to be as much condemned.

(*Continued on page* 275.)



Fitting Lathe Chucks

By "Duplex"

TO ensure that a chuck is accurately fitted, the chuck backplate should always be finally machined after it has been screwed into place on the lathe mandrel. Chucks supplied and delivered with the lathe by manufacturers of machine tools can be relied on for accurate fitting. However, the beginner may find that he needs an extra chuck for some of his lathe work.

Where an additional chuck is fitted to the lathe after delivery, then either a backplate casting can be bought and machined or, as the inexperienced worker may prefer, a backplate already machined to fit on to the mandrel nose can be obtained from the makers of the lathe, and it then remains to carry out the much easier job of turning the backplate to fit into the back of the chuck.

The machined backplate will be found to fit accurately on the plain, parallel portion of the mandrel nose, but before starting to machine the chuck seating, it is advisable to make sure that the backplate makes contact with the abutment face formed by the mandrel shoulder. Before making this check, however, the threaded bore of the backplate should be thoroughly cleaned with an old tooth brush dipped in paraffin, in order to remove any particles of swarf from the threads, as these would prevent the backplate screwing properly into place.

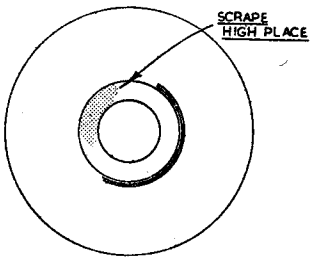


Fig. 1. Correcting the abutment face of the backplate

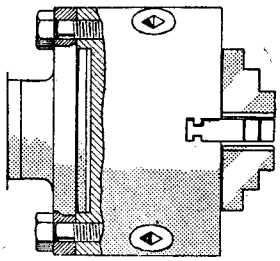


Fig. 2. Method of mounting a self-centring chuck on a backplate

Next, the face of the abutment shoulder on the mandrel is evenly smeared with a light coating of marking paste, and the backplate is screwed right home by giving it a final jerk forward.

As shown in Fig. 1, the marking may possibly be transferred to a portion only of the backplate abutment face. Should this happen, the high-spot must be attacked with a hand scraper, and testing and scraping are continued until it is found that the two surfaces make continuous contact. Where this precaution is neglected, there is always the possibility that the chuck will later run out of truth when wear has taken place at the contact surfaces. Remember, too, that the mandrel nose must always be kept clean and well oiled if wear is to be avoided, and chucks should always be stood with the jaws downwards, so as to keep particles of swarf from falling on to the backplate threads.

Machining the Backplate

Reference to Fig. 2 will show that, when fitting a self-centring chuck, the backplate is machined so that the outer rim of its front face makes contact with the outer, bolting face on the chuck body, and the central portion forms a register to engage in the recess already turned in the chuck body. But this register must be kept well clear of the bottom of the chuck recess; otherwise, the bolting faces would not meet and the backplate might be distorted when the attachment-screws were fully tightened.

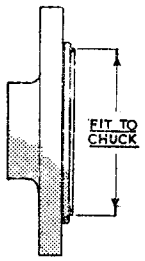


Fig. 3. Turning a trial register on the backplate

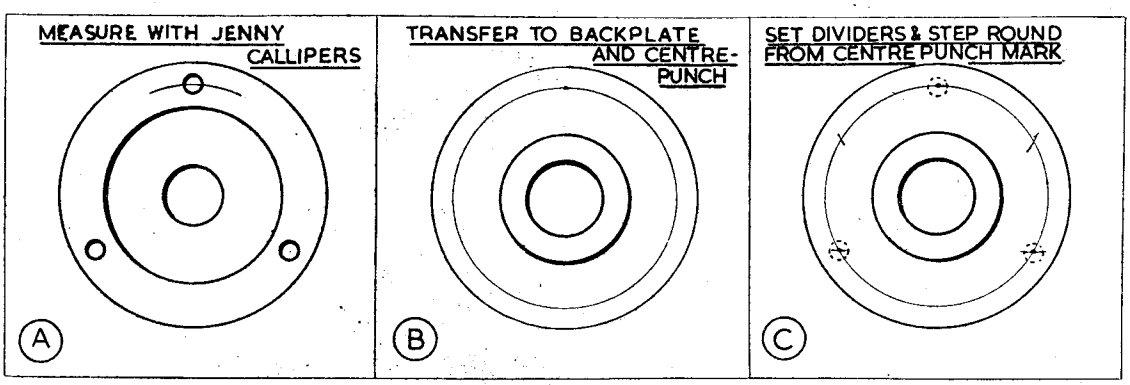


Fig. 4. Marking-out the screw-hole centres on the backplate

The first operation is to machine the backplate to the same outside diameter as the chuck body. Although an ample thickness of metal is usually provided in the machined backplate, there may not be enough to allow of a second attempt if an error is made when turning the register to size. It is, therefore, advisable for those who have any doubt in the matter to turn a narrow, trial register to fit the chuck, as is represented in Fig. 3

When the correct diameter has been found, the remaining portion of the register is turned to form a close push-fit in the chuck body; any ill-fitting part of the register is machined away, and the finished register is made some $\frac{1}{16}$ in. less in length than the depth of the chuck recess.

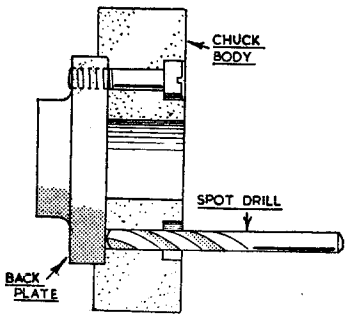


Fig. 5. Showing a four-jaw chuck mounting and the method of marking the screw-hole centres

Fitting the Attachment-screws

Self-centring chucks are usually designed so that the attachment-screws are inserted from the back, and the centres of the screw holes are, therefore, transferred from the chuck to the backplate; unless, of course, the chuck is dismantled to expose the threaded holes passing through the back portion of the body. Set the jenny calipers with one leg against the outside of the chuck body and the scriber point to the centre of one of the screw holes. Next, as represented in Fig. 4A, the calipers are worked round the periphery of the backplate to mark the pitch circle on which the screw centres lie. Make a centre punch mark on the pitch circle, Fig. 4B, and then, with the dividers set as nearly as possible to the radius, by a process of trial and error step off three equidistant points on the circle, as in Fig. 4C.

An alternative and quicker method is to scribe the pitch circle with a pointed tool while the work is still mounted in the lathe; for this purpose, the point of the tool is set to a mark scribed with the jenny calipers at a measured distance from the periphery of the backplate. The hole centres can now be set out by making use of a change wheel, secured to the lathe mandrel, for dividing the pitch circle into three.

The screw holes are next drilled well oversize to ensure that the screws do not bind and so keep the backplate from seating evenly; 1/64 in. oversize will usually be found sufficient, but if there has been an error of working, it may be necessary to draw over the holes with a round file. When mounting the finished backplate, make sure that it and the chuck are quite clean; then push the chuck into place on the register and tighten the screws a little at a time to draw the parts evenly together.

Mounting Four-jaw Chucks

As shown in Fig. 5, small, independent four-jaw chucks are usually mounted on the type of backplate that bottoms against the floor of the recess formed in the chuck body, and the periphery of the backplate then serves as the register.

Moreover, when, as shown, the attachment-screws are inserted from the front face of the chuck, the centres for the screw holes can be spotted with a well-fitting drill after the chuck has been mounted in place. However, the attachment-screws are sometimes put in from behind, and the corresponding pitch circle will then have to be transferred from the chuck body.

Instead of making a rather difficult direct measurement, a reliable way of determining the distance between the hole centre and the periphery of the backplate recess is that shown in Fig. 6.

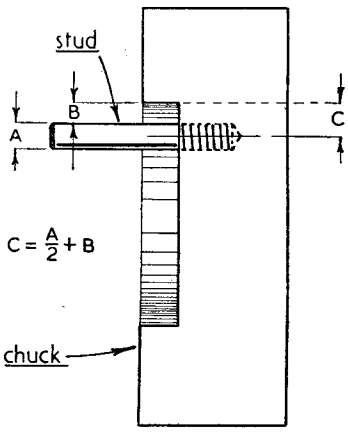


Fig. 6. Using a stud for measuring the screw-hole centres

After a plain stud or a length of threaded rod has been screwed into one of the holes, the necessary measurements are easily made. The pitch circle and the screw-hole centres are then marked-out as in the previous example, and the drilled holes must, again, provide ample clearance for the attachment-screws.

When drilling a backplate from the front, it should be supported on two blocks of equal height, so that the boss is kept clear of the drilling table and there is no tendency for the work to tip when the drilling pressure is applied.

TWIN SISTERS

(*Continued from page* 273)

That is the main outline, and as so defined, gives a picture and view of the future that is very far from the impossible. Already, many of these features are common-place amongst the true enthuiasts in the movement. What about the weeny injectors, ejectors, pressure gauges, sanding gear, brake gear and all the delightfully made components that we see only too seldom? What about the rustless-steels, super free machining at that, the Do-it-at-home stoving enamels, the reasonably priced, but still accurate tools and machines now available to most workers? The small locomotive builder of today is far, far better off for help, tools and materials, than his unfortunate predecessor who struggled away on his treadle lathe. He has longer hours of leisure, better lighting, better heating and premises, and everything except the will to go ahead in a big way.

You may not agree with the policy of " the search for perfection," or have time for it yourself; but how on earth can anyone condemn it as useless, and a waste of time? A small locomotive *can* be built to do a perfect job of work, and go on doing it; so let us find a place for the engine that has all this, and the looks and realism to go with it.

(*To be continued*)

READERS' LETTERS

● **Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.**

USEFUL INFORMATION

DEAR SIR,—The following notes may be of interest to various readers of THE MODEL ENGINEER.

Plastic Mouldings: knobs, handles and handwheels. We stock these for our own use and would be quite prepared to supply the small quantities as required by model engineers.

Tangye Mill Engine. An engine of this type, about 9 in. bore × 14 in. stroke (I am speaking from memory), is located in one of the local wood yards, and was running up to about three years ago. The engine is, or was, so located as to be almost impossible to photograph.

Rust Removal. "Metacon" 516 has proved to be one of the most satisfactory that have been tried by some friends of ours. Steel cylinders so treated remain free from rust for up to three months when stored in the presence of a salt water atmosphere.

Adhesion of Paint to non-ferous Surfaces. W.P.I. Vinyl Resin Wash Primer is claimed to cure trouble in this respect, but we have not put it to the test. These last two products are manufactured by Messrs. Croda Ltd., Croda House, Snaith, Goole, Yorks. No doubt they would supply fuller details.

Yours faithfully,

Newark. D. E. ARUNDEL.
p.p. D. Arundel & Co.

PATENTS AND THE MODEL ENGINEER

DEAR SIR,—Most reputable firms feel honoured by their productions being thought worthy of modelling, apart from the advertisement value of a good model; they often go to the expense of providing photographs and working drawings of the prototype, and take much trouble to answer innumerable questions on points of detail. On the other hand, one very occasionally hears of a firm threatening legal action for infringement of a patent by a model. It is to be hoped that your readers will not be deterred from making models for fear of being ruined by an action in the High Court; for is it not extremely unlikely that a patentee would think it worth while to sue a private individual for making a model of a patented device for private purposes? Manufacture for sale and profit is of course another matter.

Is there any record of a successful action, or even of any action that ever came into Court, for infringement by a model made for private use, as apart from production commercially? The Courts do not usually look with a very favourable eye on interference with the private individual. When Mr. Bumble made it, there may or may not have been some truth in his allegation that "The Law is a ass"; it is certainly untrue today.

If the patentee succeeded in proving infringement, he could ask for an injunction, damages, delivery up to him of the infringing model, and costs; but an injunction would not be granted unless it were shown that further infringement (as by making more such models) was to be expected; the patentee could hardly prove that he had suffered substantial damage, so that he could only expect a nominal sum under this head; he could not make much profit out of the model delivered up to him (it is not clear that he could demand more than such parts or components of the model as were held to infringe); and any costs he might be awarded would not even begin to cover his expenses.

And there is always the risk that the Court may find the patent invalid: small though this risk may be in the patentee's opinion, statistics of reported cases over thirty years show that in over 70 per cent. of them the patentee lost. For one case that came into Court, there must have been many in which the patentee was well advised not to proceed. The risk of the Court finding the patent void is too great. For the grant of a patent is *not* evidence that the patent is in fact valid. It has been said by counsel of much experience in such cases that he believed that 95 per cent. of patents granted would be held to be void on one of two grounds alone.

First, it may be void for "want of novelty." Previous use of many devices can be discovered in such books as Barber's *Engineers' Sketch-Book* and the five volumes of Holtzapfell's *Turning and Mechanical Manipulation*; to the writer's personal knowledge an electrical patent was upset on the strength of a diagram of connections in an early edition of Kemp's *Handbook of Electrical Testing*, showing a method of testing submarine telegraph cables which had been disused and forgotten for half a century or more.

Secondly, a patent may be found void for "want of sufficient description," for the specification must contain such clear and sufficient explanation of the method of manufacture that "any artisan skilled in the art" can make the device with no more information than is printed in the specification. Very many specifications fail here.

Furthermore, the Patents Acts provide that the use of a patented device for purposes of experiment and research does not constitute actionable infringement. It could be argued, with good prospects of success, that this provision would cover the fitting of a patented valve-gear to a model locomotive.

These, and many other, lines of defence give so many opportunities to counsel of experience in patent work that, when it comes to the point, few patentees would risk an action against the private maker of a single model.

In the unlikely event of being challenged, an offer, "without prejudice," of a nominal fee for a licence would almost certainly be accepted, and would be worth making to save trouble; the words "without prejudice" in the letter making the offer guard against an attempt to construe it as an admission of liability. A refusal to accept such an offer could reasonably be considered as mere bluff, an attempt to browbeat the impecunious modeller who dare not risk the expense of defending an action. It would then be wise to take advice and put the matter in the hands of a solicitor, who is unlikely to find much difficulty in getting out of the trouble. If the patentee does not confine himself to alleging that his patent is infringed, but actually threatens to take action, he has delivered himself bound hand and foot; the Patents Acts provide that such "threat" is an actionable wrong, and the person threatened can himself take the initiative and ask for a declaration that the threats are not

warranted, and for an order restraining the patentee from repeating them. Then, if the patentee loses the case, he may be ordered to pay substantial damages as well as having his patent declared void.

Patentees are not usually fools!

Yours faithfully,

"NUMERATOR."

(Editorial Note.—We would add that, although the writer of the above letter believes that his suggestions are substantially correct, neither he nor ourselves can accept responsibility for their accuracy.)

LOCOMOTIVE FUNNELS

DEAR SIR,—I remember reading, a very long time ago, an article in "Ours" on a way to form the base of a locomotive funnel to fit the smokebox. The method is so easy and gives such a realistic result, I think you may forgive me for bringing it up again.

First, find a bit of mild-steel a little larger than the largest diameter of the finished funnel. Length equal to length of funnel, plus enough to grip in chuck. Now drill and bore right through to the finished size. Next turn about half the length to almost the finished o.d. and then spend a lot of time in getting the radius at base of chimney to the right contour. Get it smooth, too, because no filing will be needed now, or later. The next move is, with a round-nosed boring-tool, to make the inside conform to about the same contour as the outside.

Now find a bit of heavy pipe, or something the same o.d. as the smokebox. Heat the part of the funnel on which you have spent so much time (gripping the unfinished part with tongs) and when it is red hot, hammer the hot end fair and square on the pipe, or whatever it is. Now cut to length, mount on a mandrel, and finish-machine the rest of the chimney. The problem of how to get it off the mandrel without using a hammer (sorry, I mean a percussion instrument) can be met, sometimes, by quickly heating the chimney—causing it to expand quicker than the mandrel—so that it will fall off (and probably get lost).

Of course, those finnicky, steel-spectacled types will say: "But why not drill the pipe at right-angles to its axis, and mount a peg in the hole to keep the chimney square to the pipe during the bashing operation?" Why? indeed! I thought of this only after I had made "Molly's" lum.

Yours faithfully,

Dunblane. ALEX. S. WILSON.

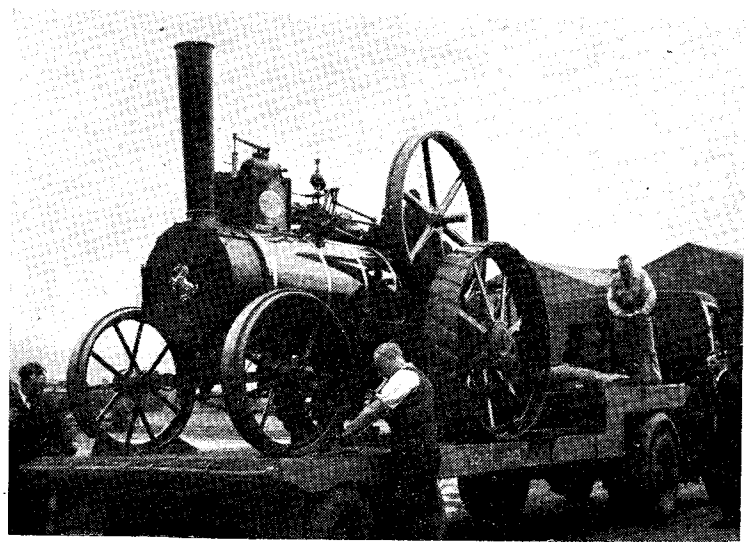
RELIC OF THE PAST

PRESENTED to the South Kensington Science Museum by the Road Locomotive Society, the Aveling & Porter 8-h.p., single-cylinder steam traction engine No. 721, seen in the photograph reproduced on this page, was delivered to the Museum recently after restoration at the Grantham headquarters of the manufacturers' successors, Aveling-Barford Ltd.

Built in 1871, only eleven years after Thomas Aveling—"Father of the Traction Engine"—first introduced his self-propelling power plant to replace the teams of horses previously used for transporting farm steam engines, this machine is one of the earliest road locomotives to be steered by its front wheels; previous models were steered by a fifth wheel located ahead of the machine and guided by a second driver seated in front of the boiler. It is also one of the first traction engines to incorporate the arrangement whereby the outside plates of the firebox were extended upwards to form simple, yet perfect, bearing supports for the working parts, and at the same time to remove all strain from the boiler. These extended hornplates, as they are called, made obsolete the practice of mounting the principal working parts on brackets bolted direct to the boiler, which, owing to the stresses set up by the engine, shafts, etc., soon led to leakages and corrosion of the bolt holes, that no amount of skill and care could eliminate.

Although designated an 8-h.p. machine, this description refers to the nominal horsepower, the unit used by insurance and classification societies as a measure of the size of the engine as distinct from its power. The indicated and brake horse powers are not known with certainty, but are believed to be 35 and 28 respectively. The cylinder is 9 in. bore by 12 in. stroke. The engine is fitted with a governor and the tender is equipped with a water elevator for filling from ponds.

Records of the machine in the possession of Aveling-Barford Ltd., show that it was despatched from Avelings' Rochester Works in 1871 to a rich estate owner in the South of England, probably in Sussex. After it had given many years service, this owner had become so attached to the engine that he had it reconditioned throughout, regardless of cost and of an Aveling & Porter representative's advice that he should purchase a new machine of more modern type. When the estate was broken up, No. 721 passed through the hands of a dealer in second-hand machinery to a gentleman near Maidstone, Kent, where it remained until the Road Locomotive Society found it last year in an advanced state of dilapidation. Having now been completely restored, it will once again be of service to humanity as an exhibit in the Science Museum's new gallery scheduled for opening to the public later this year. It will be a "live" exhibit in that an electric motor has been provided to drive the principal working parts.



A modified "DUPLEX" JIGSAW

By F. G. Bettles

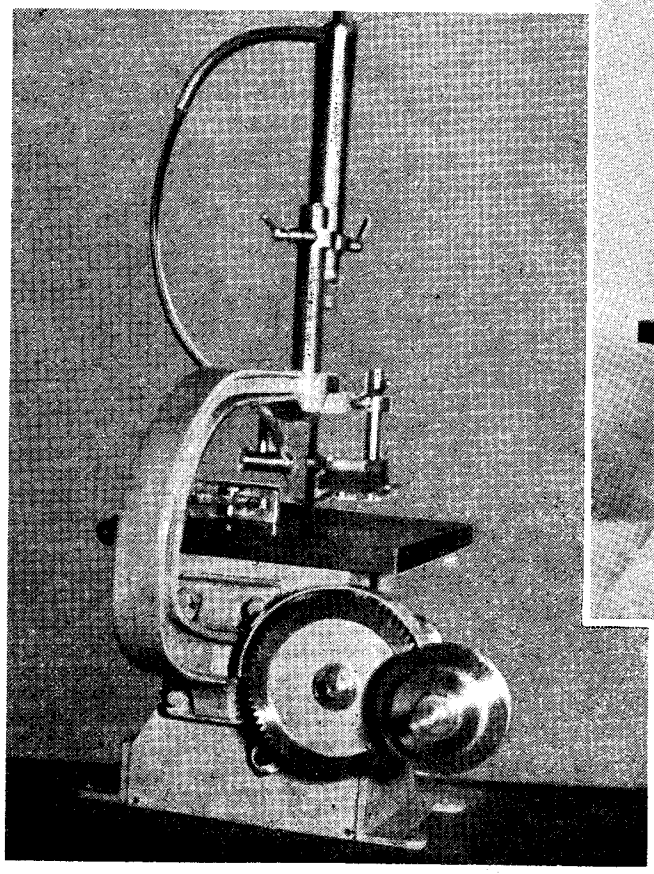
I WAS very interested in the "Duplex" design for a jigsaw machine, but in making up the one illustrated I decided to modify some of the details to suit my own requirements, and also to utilise available material. First of all, I decided to provide it with a deeper throat, so that it would cope with a larger piece of work. This entailed altering the frames, and instead of the built-up structure used by "Duplex," I employed a curved arm as shown, bolted to the back of the frame plates. Secondly, the table is made capable of tilting, as this is very useful when pattern making, to provide "draught" or taper on the sides. Thirdly, I found it difficult to get a pulley large enough to provide an efficient drive, so I decided to incorporate a reduction gear of 3½ to 1, using 20 d.p. gears, the pinion having 20 teeth, and being built up of fibre faced with gunmetal cheeks before cutting.

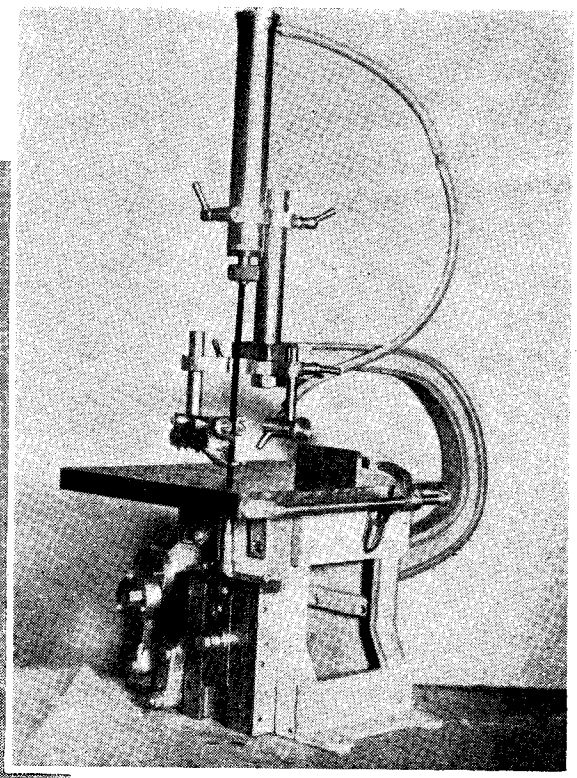
Except for the four castings employed, the structure is as designed by "Duplex," but several parts were made from the photographs, before detail drawings were published. The slide and its frame were milled from parts of a tractor plough, found on the scrap heap, and several other odds and ends came from similar sources.

The gears were cut with a home-made cutter, as described by "Duplex"; I have made about 15 of these in various pitches, and one has cut over 500 teeth and is still in good condition.

One item in the "Duplex" design is open to criticism, namely, the form of reciprocating motion, which does not appear to offer any advantages over the Scotch crank type. I have a machine with this motion, used for filing and keyway cutting, and it appears to me that the weight of the motion helps the cutting stroke, and also partly cancels the pull of the spring.

Too old at 40?—Not even at "70 plus"!





This jigsaw has a deeper throat than that in the original "Duplex" design, which is useful when sawing larger work

*Left: **Rear** view, showing reduction gear of 3½ to 1 to provide an efficient drive*